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# SURGERY AND THE BASIC SCIENCES

## RECENT STUDIES OF THE FACTORS INVOLVED IN THE COAGULATION OF BLOOD, INCLUDING A REVIEW OF VITAMIN K

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### FACTORS INVOLVED IN THE COAGULATION OF BLOOD

ACCORDING to present concepts (1 and 3), there are two phases to the coagulation of blood and four substances are primarily involved. These are generally expressed as follows:

(a) Prothrombin + thromboplastin + calcium = thrombin.

(b) Thrombin + fibrinogen = fibrin.

Three of the primary factors are represented in (a) and these react to form thrombin which in turn reacts with the fourth substance, fibrinogen, to form the insoluble protein fibrin. The bleeding tendency in any given case may not be adequately explained without consideration of related vascular phenomena (2). A classification of hemorrhagic disease based on defects of the coagulative mechanism has been presented by Quick (3), who points out the fact that a defect in any of the four factors involved in the clotting mechanism may keep the reaction from reaching the state of completion.

It should be pointed out, however, that there are numerous theories regarding the substances and processes concerned in coagulation, and that the only point conceded by all theories is the essential rôle of fibrinogen.

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*Prothrombin.* The plasma content of this substance is relatively constant for any given species (4). It is the precursor of thrombin, which in turn is the active coagulative "enzyme." Prothrombin is thought to originate in the liver (5). It has been described (6) as a carbohydrate-containing protein associated with the globulin fraction of the plasma proteins; it is sensitive to acid, inactivation beginning at pH 4.8 and reaching completion at pH 3.5; on the alkaline side inactivation begins at pH 10. Inactivation by heat is partially complete at 40° C. for thirty minutes, and virtually complete at 60 degrees.

Determinations of the activity of plasma prothrombin have been made largely according to either the method of Quick (7) or that of Warner, Brinkhous, and Smith (8). A method particularly suited for infants has been described (9). There are various figures for the concentration of prothrombin in the blood below which hemorrhage is likely to occur. As much as 80 per cent of the normal plasma prothrombin activity may be lost before the coagulation time is appreciably increased, according to Quick and his coworkers (10). Butt (11) has obtained results which indicate that bleeding may occur when the prothrombin is considerably higher (from 40 to 50 per cent of normal), and also that what appears to be cholemic bleeding may occur with a normal prothrombin time (12). Various results have been obtained for the prothrombin content of the blood

plasma of newly born infants (13, 14, 15, 16, 17). However, it appears that the relatively high prothrombin activity which may be expected during the first day of life is likely to decline from the second to the sixth or eighth day and after that increase, and that during this time there may be considerable daily variation in the plasma prothrombin level. The influence of Vitamin K on prothrombin will be considered when this vitamin is reviewed.

The influence of storage upon the prothrombin content of blood is a question of practical importance. The prothrombin time of stored blood has been found to be prolonged (18), the decrease in activity paralleling the duration of storage. These results have been confirmed (19). Little change in the prothrombin activity of stored blood has also been reported (20). The difference in results may be due to a difference in the methods employed to determine prothrombin activity (19), or to some variable factor involved in the stability of prothrombin.

*Thromboplastin.* The substance contained in platelets and in many tissue extracts, which, acting in conjunction with calcium, converts prothrombin into thrombin, is known as thromboplastin or thrombokinase. The latter term implies that it is an enzyme activator. Although the actual nature of the reaction is unknown, yet it is of interest to know that trypsin can also convert prothrombin into thrombin (21, 47, 48). The brain, lung, and thymus are particularly rich tissue sources of thromboplastin; so far as the blood itself is concerned the platelets are the recognized source, although the plasma itself may make some contribution to the activation of prothrombin (79). Howell's theory teaches that thrombokinase inactivates antiprothrombin, which some believe is heparin.

The chemical nature of this activator suggests that it may be both protein and lipoid in character. A potent activator for the clotting of plasma was obtained from the phosphatide fraction of horse blood platelets (22) by Chargaff, Bancroft, and Stanley-Brown. They suggested that the natural activator for the blood-clotting mechanism may be a specific protein complex with cephalin. A thromboplastic protein prepared from lung tissue has been studied (23). From this protein was isolated a phosphatide fraction and with the removal of the lipoid group the protein lost its thromboplastic properties. The protein was capable of stimulating antibody formation. It was further found (24) that the treatment of the thromboplastic protein from lung with heparin resulted in a displacement of the phosphatide fraction by heparin and that the heparin-protein complex had marked anti-coagulant properties. The importance of cephalin in the activation of the precursor of thrombin led to the suggestion (25) that denaturation phenomena following the shedding of blood make more cephalin "available" than can be taken care of by the antithrombic factors contained in blood. Leathes and Mellanby (26) reported the isolation of a non-lipoid thrombokinase from brain tissue and daboia venom. These workers also report that lecithin increases the activity of thrombokinase. This finding is in contrast with the more generally accepted view. Chargaff and Cohen (27), continuing their observations on the thromboplastic properties of "Kephalin," found that a lysophospholipid preparation containing 30 per cent lysokephalin was without influence upon the blood-clotting mechanism.

The use of a purified thrombin solution as a hemostatic agent has been suggested (28). The potency of various commercially available thromboplastic substances has been studied (29). These included snake venom, bovine brain extract, beef lung extracts, bovine blood extracts, and concentrated horse serum. Of the 17 products examined, 9 were found to be practically inactive, and the only products found to be significantly active were those suitable for local or oral use.

A study of the mechanism of the action of saliva upon blood coagulation (30) indicates that saliva accelerates the coagulation of blood by acting as a thromboplastin. The active principle can be precipitated by ammonium sulfate; it is thought to be cellular in origin, and may be a lipoprotein.

Since the platelets are an important source of thromboplastin, it follows that qualitative or quantitative abnormalities in the platelets may alter the coagulability of the blood. The prothrombin conversion rate of the hemophiliac is extremely slow and is brought to normal by the addition of a small amount of thromboplastic agent (31). The clotting of hemophiliac blood by crystalline trypsin as reported by Tyson and West (32) has been confirmed by Ferguson (33) who believes that a deficiency in thromboplastic enzyme in the plasma is a logical explanation of the delay in coagulation in hemophilia. Howell, in a recent review of the problem of hemophilia (34), indicates that the defect may not be merely a matter of alteration in the structure of the platelet which renders it more stable than normal, but that some element of the plasma (80) which normally has to do with the agglutination and breakdown of the platelets may be at fault. Idiopathic

thrombocytopenic purpura illustrates the effect which a marked decrease in platelets may have upon the coagulability of the blood and the tendency to bleed (35). This condition also shows that there is normally a wide margin of safety between the number of platelets necessary for normal clotting and the concentration at which bleeding may occur. The decrease in available thromboplastin resulting from a thrombocytopenia does not adequately account for the importance of the platelet in blood clotting and related vascular phenomena (see section on fibrinogen). It has been shown that Vitamin K fails to alter the abnormal coagulation of hemophilia and thrombopenia (85, 86).

*Calcium.* It is quite generally held that ionized calcium is essential for the conversion of prothrombin into thrombin (36, 37). That calcium is merely a catalyst and that this reaction will occur spontaneously in the presence of water, acetic acid, and oxalic acid has been claimed (38). Mellanby and Pratt (38) found that less than 0.3 mgm. per cent of calcium is required for the coagulation of fowl plasma by thrombokinase. The minimal calcium-ion concentration at which the coagulation of diluted citrated plasma occurred was 0.35 mgm. for human, and 0.24 mgm. for dog plasma, according to Ransmeier and McLean (39). They found further that the minimal coagulation time for both dog and human plasma is approached above a calcium-ion concentration of 1.25 mm. per liter. Crane and Sanford (40) studied the coagulation time and serum calcium content and found a normal clotting time with the calcium content of serum ranging from 5 to 20 mgm. per 100 c.cm. A low serum calcium in a case of hypoparathyroidism was accompanied by a normal clotting time (41). There is some evidence to indicate that an actual compound of calcium and prothrombin occurs as an intermediary product in the conversion of the latter into thrombin (42, 43).

It has been shown by Ferguson that calcium, besides being an essential factor in the conversion of prothrombin into thrombin, alters the platelets in some way so as to disturb the osmotic pressure within the platelet and result in its rupture (44).

*Thrombin.* Evidence favoring the belief that thrombin is an enzyme which acts specifically on fibrinogen to form fibrin has been summarized (45). The quantitative relationship between calcium and cephalin in experimental thrombic mixtures has led to the conclusion (46) that an intermediary substance in thrombin formation is made up of a colloidal complex of all three precursors of thrombin, viz., prothrombin, cephalin, and calcium. Extension of the original observations (47) as to the ability of crystalline trypsin to clot blood without the aid of cephalin and calcium indicates that in small concentrations the activity of trypsin is dependent upon calcium (48). It is postulated that thrombin formation may be the mobilization of cephalin and calcium on the surface of protein (prothrombin), with the elaboration of a substance capable of clotting fibrinogen. Study of the action of thrombin upon a solution of purified fibrinogen indicates that all of the fibrinogen nitrogen appears as fibrin nitrogen (49). The action of thrombin on fibrinogen is considered to be a hydrolytic one of which the formation of fibrin is an intermediary step (50). That 9 or 10 per cent of fibrin nitrogen does not appear as fibrin is also indicated. Other workers (49) say this discrepancy represents the solubility of fibrin.

The chemical nature of thrombin is similar to that of prothrombin (6). In a saline solution thrombin is permanently inactivated by acid at pH 3.5, and reversibly inactivated in the zone between pH 3.5 and 4.1. According to Glazko and Ferguson (51), thrombin preparations are most stable between pH 4 and 5. The inactivation of thrombin by serum albumin has been demonstrated by Quick (52). By means of a standard thrombin solution blood can be tested for the presence of heparin or other anti-thrombogenic agents (53).

*Fibrinogen.* This soluble protein, which probably originates in the liver (83, 84), belongs to the globulin fraction of the plasma proteins. The action of thrombin converts it into the insoluble protein fibrin. When blood clots, the fibrin precipitates in fine needles and threads which enmesh the cellular constituents of the blood. Tocantins (54) has shown that the retraction of a clot is accompanied by the bending and twisting of the fibrin strands and that the adherence of platelets to the strands of fibrin is instrumental in bringing about the normal shrinkage of the clot. The fibrin framework of the clot is strengthened by the accumulation of platelets at the intersection of fibrin needles or strands.

A reduction in plasma fibrinogen from the normal range of 0.2 to 0.4 per cent has been reported to occur in certain deficiency diseases (55). Smith, Warner, and Brinkhous (56) found that liver injury did not reduce the plasma fibrinogen of dogs so readily as it did the prothrombin, and that the latter returned to normal less readily than the former; also, that abscesses which elevated the fibrinogen content of the blood were

without effect upon the plasma prothrombin level. A congenital deficiency in fibrinogen has been reported by Macfarlane (57). This worker has also shown that an operation may cause some change in the structure of fibrin which results in lysis and fragmentation of the clot following the trauma (57a).

*Anticoagulants.* Substances which interfere with the coagulation of blood may do so by inhibiting the action of any of the substances involved in the reactions which lead to the formation of fibrin. The *in vitro* anticoagulants usually employed interfere with the clotting of blood by combining with calcium. A study of the effect of varying amounts of sodium oxalate upon the clotting of plasma has been reported recently (58). The *in vivo* anticoagulant that has aroused the most study and interest is heparin. It is known that this substance will prevent the clotting of blood whether shed or circulating. The failure of blood to clot after peptone or anaphylactic shock has been explained by an increase in the concentration of heparin in shocked plasma (62), and the fact that this heparin originates in the liver is indicated by the fact that no antithrombin is found in the blood of shocked liverless dogs (59). Not only has the presence of antithrombin been demonstrated in the blood of shocked animals (60), but the isolation of crystalline heparin from the blood of dogs after anaphylactic shock has been reported as well (61).

The manner in which heparin prevents the coagulation of blood is not entirely understood. It has been suggested (63) that heparin forms an antithrombin by combining with a serum protein and that the serum protein involved is probably the albumin fraction (64). The heparin-protein complex then combines with thrombin thereby preventing it from reacting with fibrinogen (63). It has been shown that neutral salts are necessary for this reaction (63). It has also been reported (65) that heparin prevents the conversion of prothrombin into thrombin and that for this effect some non-diffusible constituent of the plasma is required. Salamine, a basic protein that combines with heparin (66), is an anticoagulant acting in combination with heparin, and this anti-coagulant effect has been shown to be due to the anti-prothrombic effect of the combined heparin and salamine (67). A comparison of the anti-coagulant effects of heparin and of diethylamine indicates that these substances possess similar anti-coagulant properties. Cephalin was found to inhibit the anti-coagulant effects produced by heparin in directly proportional amounts (68).

The separation of a lipid fraction from the brain and spinal cord of various animals which was capable of inhibiting the coagulation of blood plasma has been reported (69). This lipid is contained in the cerebroside fraction and is associated with sphingomyelin. In a further study it was shown that the sulfuric-acid esters of the cerebrosides, cerebron and kerasin, possess marked anti-coagulant activity. The author also points out that sulfuric-acid esters of polysaccharides act as strong anticoagulants. The anti-coagulant properties of various sulfur compounds such as cystine and taurine have been reported (70). Others (69) claim that a variety of organic substances with acidic groups inhibit clotting and that cystine is without anti-coagulant effect, while its hydrochloride is an anti-coagulant because of its acidity. However, this hardly seems an adequate explanation for the fact that cystine and methionine administered orally to human subjects prolonged both the bleeding and coagulation time (69).

The presence of a circulating anti-coagulant has been reported recently in a patient with a generalized lymph-node tuberculosis (71). This anti-coagulant increased the coagulation time of normal blood and was found to be associated with the globulin fraction of the plasma proteins; it was relatively thermostable and non-diffusible and would .not react with salamine as does heparin. Quick has confirmed (72) and extended the observations of Roderick (73), that the decreased coagulability of the blood in sweet-clover disease is due to a disturbance in the prothrombin. He found that spoiled sweet clover fed to rabbits would cause the prothrombin level of the blood to drop to a low level and that the hemorrhagic level paralleled the reduction in prothrombin. Whether there is an inhibition or destruction of the plasma prothrombin is not known. A scheme for the concentration of the active hemorrhagic principle of spoiled sweet clover has been reported (74). By this method a 200-fold concentration has been effected, and 0.6 gm. of the concentrate fed to a standardized susceptible rabbit reduced the plasma prothrombin to 10 per cent of normal in from forty to forty-eight hours. While the identity of the active principle of the extract is still unknown, certain classes of compounds have been eliminated.

Experimental and clinical studies on the use of intravenously injected heparin as a means of preventing thrombus formation have been reported (75, 76, 81, 82). Its use after mesenteric thrombosis resulted in no recurrences following operation and its value in the prevention of

thrombosis after splenectomy is suggested (77). The ability of heparin to prevent the coagulation of blood was found to be the same *in vivo* as *in vitro* (78). The rate of removal of intravenously injected heparin from the circulation of the dog was found to be proportional to its concentration if 1 unit (1/100 mgm. of the barium salt of heparin) or less of heparin was present per c.cm. of blood, and at a constant rate (2 units per kgm. per min.) when 2 units or more were present per c.cm. of blood (78).

## Vitamin K

*Chemistry.* Vitamin $K_1$ from alfalfa has been isolated in pure form (1–4). The substance is a light yellow oil which changes to a crystalline form on cooling an acetone or alcohol solution. The behavior of this substance upon hydrogenation and oxidation, its sensitivity to light and alkali, and its absorption spectrum suggested a quinoid structure (3). Reasoning from degradation products of the vitamin, the Doisy group first suggested that $K_1$ was 2-ethyl-3-phytyl-1, 4-naphthoquinone (5). Fieser and his coworkers compared Vitamin $K_1$ from alfalfa with different synthetic naphthoquinones in regard to their absorption spectra and reactions with sodium ethylate, and as a result they published the first correct formula for Vitamin $K_1$: 2-methyl-3-phytyl-1, 4-naphthoquinone (6). This structure was confirmed in a later publication by the Doisy group (7). Three independent syntheses of Vitamin $K_1$ have been reported (8–11).

Vitamin $K_2$ from putrified sardine meal is a light yellow crystalline solid with a melting point between 50.2 and 52° C. (3). The Doisy group (12) found $K_2$ to be a 2, 3 disubstituted 1, 4-naphthoquinone with a methyl group in the 2 position. A somewhat different structure has been suggested by Fieser (6).

*Synthetic substances with K activity.* The first report on a simple synthetic compound with anti-hemorrhagic activity was that by Almquist and Klose (13) who found that phthiocol (2 methyl-3-hydroxy-1, 4-naphthoquinone) possessed some Vitamin K activity. This substance had been isolated from tubercle bacilli (14) and later synthesized (15). The activity of 2-methyl-1, 4-naphthoquinone was investigated by several workers (16–18). Its exceptionally high activity was first recognized by Ansbacher and Fernholz (16). During the past year a tremendous number of synthetic substances have been assayed for Vitamin K activity. Riegel (19) has presented an excellent summary of this extensive work. Some forty-five synthetic compounds have been shown to possess anti-hemorrhagic activity. Of particular interest are the water-soluble active substances which are suitable for parenteral administration. Some of these will be considered in more detail later. In addition to these substances, some sixty-two synthetic products have been proved to be inactive. From this work a number of generalizations relating structure to activity may be advanced (19).[1]

1. The 1, 4-naphthoquinone structure is most essential.

2. The greatest activity occurs when a methyl group is in the 2 position. If one hydrogen atom in the 2 methyl group is replaced by another group the activity is greatly diminished.

3. Substitution of alkyl or hydroxyl groups in the benzenoid ring of the 1, 4-naphthoquinones either destroys or greatly reduces the activity.

4. Substitutions in the 3 position of 2-methyl-1, 4-naphthoquinone also lowers the activity. On a weight basis, the groups in the natural Vitamins $K_1$ and $K_2$ lower the activity of 2-methyl-1, 4-naphthoquinone, but all have the same activity on a molar basis.

5. Derivatives of active 1, 4-naphthoquinones, such as hydroquinones, quinhydrones, hydroquinone esters, or even 1, 4-aminonaphthols exhibit Vitamin K activity.

*Mode of action of Vitamin K; rôle of the liver.* The existence of an anti-hemorrhagic vitamin was first suggested by Dam (20) who observed a hemorrhagic tendency in chicks maintained on a special fat-free diet. It was shown (21) that the defect in the clotting mechanism in these animals was not due to a disturbance in the fibrinogen, calcium, or thrombocytes of the blood, or to a deficiency in the thrombokinase of the tissues, and later (22–23) a deficiency in prothrombin was found to be responsible. Apparently, the mechanism by which Vitamin K prevents a hemorrhagic tendency is to stimulate the production of plasma prothrombin (22, 23, 24). The exact manner in which Vitamin K is utilized in the production of prothrombin is not yet known. Vitamin K does not act as prothrombin *in vitro* (25). The fact that prothrombin precipitates from the plasma of normal chicks did not show Vitamin K activity was interpreted by Dam and his associates (25) to mean that Vitamin K is not a prosthetic group in the prothrombin molecule, but that its presence in the tissue stimulates prothrombin production.[2]

[1] Since this was written, an excellent review of this subject by Fieser, Tishler, and Sampson has appeared in *J. Biol. Chem.*, 1941, 137: 659.

[2] It has recently been suggested (118) that Vitamin K may constitute a prosthetic group in an oxidation-reduction enzyme system, possibly related to liver cathepsin.

Experimental (26–34) and clinical (35–45) studies appear to have demonstrated that the liver is essential for the manufacture of prothrombin and the utilization of Vitamin K. Partial hepatectomy in the rat (26) and total or partial hepatectomy in the dog (30–32) results in a marked decrease in plasma prothrombin. Controlled experiments demonstrated that the defect in the clotting mechanism which follows such procedures could not be explained on the basis of anesthesia, hemorrhage, blood dilution, laparotomy, or a decrease in plasma fibrinogen (26, 30). A fall in plasma prothrombin also occurs following mechanical trauma to the liver of the dog (31, 33), and after liver damage produced by carbon tetrachloride in the rat (27) and by chloroform anesthesia in the dog (28). In the last instance, the prothrombin deficiency could be produced without a change in the plasma fibrinogen. The hypoprothrombinemia produced in the rat by carbon tetrachloride poisoning and in the dog by chronic chloroform intoxication does not respond to Vitamin K administration (27, 34). This experimental evidence is supported by an increasing number of clinical reports (35–45, 104) stressing the fact that hypoprothrombinemia in patients with extensive liver damage fails to respond to the administration of Vitamin K, and pointing out the existence of a prothrombin deficiency in certain diseases of the liver (Laënnec's cirrhosis, Banti's disease) (45). There is some evidence to indicate that Vitamin K may be stored in the liver (31, 55).

The liver plays a second indirect rôle in the utilization of Vitamin K by furnishing bile which is essential for the absorption of fat-soluble Vitamin K from the intestine. A hypoprothrombinemia in certain patients with jaundice was first demonstrated in 1935 by Quick, Stanley-Brown, and Bancroft (46). It was also shown that the hemorrhagic tendency observed in dogs with a chronic biliary fistula was due to a prothrombin deficiency and could be prevented by the return of bile to the intestinal tract (47). Early in 1937, Quick (48) suggested on theoretical grounds that these observations might be explained on the basis of inadequate absorption of a substance similar or identical with Vitamin K because of the absence of bile in the intestine. Greaves and Schmidt (49, 50) demonstrated that the hemorrhagic tendency in rats with a biliary fistula was associated with a hypoprothrombinemia which could be prevented by the oral administration of bile or of alfalfa concentrates rich in Vitamin K. Further experimental studies have demonstrated that bile is necessary for the absorption of Vitamin K and that the hypoprothrombinemia associated with obstructive jaundice or biliary fistulas in rats (50, 54, 55), dogs (51, 31), and chicks (52, 56) can be prevented by the administration of Vitamin K and bile salts. The first report on the use of Vitamin K in the treatment of human cases was by Warner, Brinkhous, and Smith (53). Shortly after this, two other reports appeared (57, 58), and since that time this work has been confirmed many times (for literature see reference 19).

### EXPERIMENTAL AND CLINICAL K DEFICIENCIES

*1. Dietary deficiency.* A K-avitaminosis can be readily produced by dietary means in chicks and various avian forms, but early workers were unsuccessful in producing a dietary deficiency in the ordinary laboratory mammals (rats, guinea pigs, dogs) (59). More recently, several reports have appeared which indicate that a dietary deficiency may be produced in mammals. It has been reported that mice on a Vitamin K-free diet develop a prolonged bleeding time (60). Greaves (54) observed a hemorrhagic tendency in 12 of 77 rats raised for a considerable time on a Vitamin K-free diet. A prothrombin deficiency has been produced in rats with a diet containing a high percentage of mineral oil, which apparently interferes with the absorption of Vitamin K from the intestine (61). The difficulty in producing a dietary K-avitaminosis in mammals may be due to the bacterial synthesis of Vitamin K in the intestine. It has been shown (62–64) that certain microörganisms, including the colon bacillus, are capable of synthesizing the vitamin in food, feces, or pure culture. Vitamin K activity has been found in the horse, cow, sheep, hog, and human feces (65). Greaves has shown (54) that an ether extract of the feces of rats on a Vitamin K-free diet completely protects young chicks from Vitamin K deficiency when added to the basal diet.

A K-avitaminosis in man on a dietary basis appears to be quite rare. After a week on a Vitamin K-free diet, the normal individual shows no deficiency in prothrombin (52). Recently, however, some evidence has appeared which seems to indicate that a dietary deficiency may be responsible for a K-avitaminosis in man (66–67, 86).

*2. Liver and biliary tract disease.* The Vitamin K deficiency which occurs in laboratory animals and in patients with biliary obstruction, biliary fistula, and liver injury or disease has been cited above.

*3. Vitamin K deficiency in the newborn.* In 1937, Brinkhous, Smith, and Warner (68) reported that the prolonged clotting time which

had previously been demonstrated in newborn infants (69) and in hemorrhagic disease of the newborn (70) was associated with a hypoprothrombinemia. Recently a considerable number of studies on this problem have appeared. The prothrombin level of the infant although apparently normal at birth (71–73) soon begins to fall so that during the first few days of life the plasma prothrombin may reach dangerously low levels (71–79). It apparently returns to normal in about a week. The cause of this "physiological hypoprothrombinemia" is not yet understood. It has been suggested that it is due to a lack of Vitamin K synthesis in the intestine because of the absence of a bacterial flora (72, 74, 78), or to functional immaturity of the liver which does not properly produce prothrombin or which produces bile that is quantitatively or qualitatively inadequate to permit absorption of the vitamin from the gut (78). There is evidence to indicate that this hypoprothrombinemia may be eliminated by the administration of Vitamin K concentrates or synthetic Vitamin K substitutes to the newborn infant (71, 75, 76, 77, 78, 81, 82), or to the mother before delivery (73, 76, 77, 78, 80, 81, 82). The suggestion was soon made that this hypoprothrombinemia was the immediate cause of hemorrhagic disease of the newborn (71–74, 77, 79). A number of investigators observed prolonged prothrombin times in hemorrhagic disease of the newborn, icterus gravis neonatorum, anemia neonatorum, and hydrops congenitus (71, 74, 76, 78, 83). In 1939, Nygaard (71) reported 3 cases of hemorrhagic disease which responded promptly to Vitamin K therapy. Dam (74) reported a similar case. More recently, Poncher and Kato (83) have reported a series of 22 cases of hemorrhagic disease of the newborn successfully treated with synthetic Vitamin K preparations. The infants in these cases all showed active bleeding and prolonged prothrombin time before treatment. In most cases, the prothrombin time was shortened within from two to six hours after Vitamin K therapy and clinical improvement was prompt and permanent. No blood transfusions were given.

Vitamin K therapy appears to be indicated in all surgical procedures on the newborn and in the hypoprothrombinemia associated with hemorrhagic disease of the newborn, intracranial hemorrhage, icterus gravis, anemia neonatorum, and hydrops congenitus (73, 78). Some believe that the administration of Vitamin K to the mother before delivery will effectively reduce the incidence and severity of intracranial hemorrhage in the newborn (73, 76, 78).

*4. Other causes of vitamin K deficiency in man.* It has been shown (84, 85) that the hemorrhagic tendency seen in some cases of sprue is due to K-avitaminosis. A hypoprothrombinemia which responded to Vitamin K has been observed in various intestinal disorders including sprue, intestinal polyposis, ulcerative colitis, intestinal fistula, postoperative gastric retention, gastrocolic fistula, and intestinal obstruction (85). Recently 57 cases of hypoprothrombinemia in the absence of jaundice or evidence of advanced hepatic disease have been reported (86). Included in this series were examples of tropical sprue, ulcerative colitis, regional enteritis, and many other conditions. In some cases, correction of a defective diet alone seemed to correct the deficiency. A Vitamin K deficiency has been reported in a case of cholecystitis in the absence of jaundice or hepatitis (87). It has been suggested that Vitamin K may control the hemorrhagic tendency in certain cases of hypertension and uremia (88), but insufficient evidence is available.

*Synthetic substances which have been used clinically in the treatment of Vitamin K deficiencies.* A number of clinical reports describing the use of various synthetic Vitamin K preparations are now available. Most of the recent work has been directed toward the search for water-soluble substances suitable for parenteral use. Such preparations would be of value particularly in patients with nausea and vomiting (so often seen in biliary-tract disease) who are unable to tolerate oral medication.

The first synthetic product to be employed parenterally in the clinic was phthiocol. This substance was given intravenously, a large volume of a dilute solution being used, and favorable results were obtained (89–91). Synthetic Vitamin $K_1$, although practically insoluble in water, has been given intravenously with success in the form of a colloidal suspension in glucose (92). Although 2-methyl-1, 4-naphthoquinone is soluble only to the extent of 1 mgm. in 10 c.cm. of water, it is active in such small quantities that for practical purposes it can be considered water soluble. It has been used intravenously (93, 104), as has its bisulfite addition compound which is water soluble (93). Two-methyl-1, 4-naphthoquinone dissolved in corn oil has been successfully used intramuscularly in doses of from 2 to 10 mgm. (94, 95). Two new water-soluble substances have recently been employed clinically. Butt, Snell, and Osterberg (93) gave 1, 4-dihydroxy-2-methyl-3-naphthaldehyde intravenously to 10 patients and obtained a favorable response in all but 2 cases, the latter

showing evidence of severe liver damage. Aggeler, Lucia, and Goldman (91) and Broun (96) used 4-amino-2-methylnaphthol hydrochloride ($K_5$) intravenously in doses of from 5 to 30 mgm. with favorable results.

In addition to these preparations, a number of water-soluble synthetic compounds have been shown to possess anti-hemorrhagic activity by animal assays, but up to the present time they have not been tested clinically. Included among these are:

2-methyl-1, 4-disuccinylnaphthohydroquinone (97)
2-methyl-1, 4-naphthohydroquinone monosuccinate (98)
4-amino-3-methyl-1-naphthol (98, 99)
2-methyl-1, 4-naphthohydroquinone (100, 101)
Na-2-methyl-1, 4-naphthohydroquinone diphosphate (100, 102, 103)
Na-2-methyl-1, 4-naphthohydroquinone disulfate (100, 102)
K-2-methyl-1, 4-naphthohydroquinone disulfate (98)
2-methyl-1, 4-naphthalene dioxydiacetic acid (100)

As might be expected, it has been shown (115) that bile salts are not necessary for the absorption of water-soluble Vitamin K preparations from the gut.

*Relative potencies of some Vitamin K preparations.* Two-methyl-1, 4-naphthoquinone is from 500 (106) to 4,000 (107) times as potent as phthiocol. Although earlier reports were contradictory, it is now generally agreed that 2-methyl-1, 4-naphthoquinone is more active than either natural or synthetic Vitamin $K_1$. The relative potencies reported by various authors vary from 2 or 3 to 1 (108–109) to 30 to 1 (110). The activity of the water-soluble hydrochlorides of 4-amino-2-methyl-1-naphthol and 4-amino-3-methyl-1-naphthol compares favorably with that of methylnaphthoquinone (99).

*Toxicities; clinical observations.* No toxic reactions were noted from the intravenous injection of phthiocol in doses as large as 300 mgm. (89–91). Ten milligrams of synthetic Vitamin $K_1$ given intravenously produced no toxic effects (92). No evidence of toxicity has been observed from 2-methyl-1, 4-naphthoquinone given orally, intramuscularly, or intravenously in doses up to 16 mgm. (94, 111, 91, 112, 93, 113). Large quantities of 2-methyl-1, 4-naphthoquinone (180 mgm.) given orally produced vomiting and porphyrinuria (105). This is an enormous dose, however, and for practical clinical purposes the toxicity of this substance is not a problem, since from 2 to 10 mgm. is entirely sufficient for an adult dose.

*Experimental studies.* Thirty milligrams per kilo of 2-methyl-1, 4-naphthoquinone given intramuscularly to dogs produced vomiting, albuminuria, and porphyrinuria (105). A transient albuminuria was produced by 60 mgm. per kilo of 2-methyl-1, 4-naphthoquinone diacetate. These dosages are many times greater than the therapeutic dose. Molitor and Robinson (114) studied the toxicities of phthiocol, Vitamin $K_1$, and 2-methyl-1, 4-naphthoquinone in mice, rats, and chicks. Phthiocol was the most toxic, while Vitamin $K_1$ produced no toxic effects. The oral lethal dose in mice was 200 mgm./kilo for phthiocol and 500 mgm./kilo for the methylnaphthoquinone. In chronic experiments, 350 mgm./kilo/day of phthiocol, or 500 mgm./kilo/day of the methylnaphthoquinone produced some fall in the red blood count and hemoglobin of rats. It is to be noted that these doses are extremely high. A low toxicity for tetrasodium-2-methyl-1, 4-naphthoquinone diphosphoric ester has been reported by Foster (116) and confirmed by Smith and Ivy (117).

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# ABSTRACTS OF CURRENT LITERATURE

## SURGERY OF THE HEAD AND NECK

### HEAD

**Jentzer, A.: Skull Injuries Caused by Projectiles and Craniocerebral Wounds** (Durch Projektile verursachte Schaedelverletzungen und Kranio-cerebrale Wunden). *Schweiz. med. Wchnschr.*, 1940, 2:648.

In the present war there are fewer skull and brain injuries than there were during the World War because in all armies every soldier without exception must wear a steel helmet. During the World War the mortality of skull injuries was 48 per cent. The treatment of brain injuries is carried out today with much greater success than in previous wars. The experiences of neurosurgery have exerted a very favorable influence upon the treatment of fresh skull and brain injuries. All persons with skull and brain injuries, without exception, should be transported as soon as possible to military hospitals. Cases of intracranial hematoma should, on the strength of the well known symptoms (free interval, unilateral mydriasis, neurological signs, spontaneous exophthalmos, threatening aggravation of the general condition, external injury of the hairy portion of the scalp), be trephined early. In accordance with the severity of the condition cranial injuries can be brought to base hospitals within from twelve to twenty-four hours for surgical aid. Vincent emphasizes rightly that a skull injury can be safely operated upon during the first twenty-four hours when the patient is still in a very good condition with good chances of success, in contradistinction to perforating injuries of the abdomen. Even though the brain tissue offers the greatest resistance to the entrance of infection, nevertheless, all skull injuries should be brought to operation as early as possible. Splinters of shrapnel or hand grenades should be removed as early as possible from the brain tissue, much sooner than penetrating bullets of the infantry. Of course, the prognosis is much more favorable if the operation can be undertaken in a specially prepared surgical aid hospital.

The transport situation is such in modern armies that the injured can be brought to a surgical operating room either by automobile ambulance or flying ambulance within a short time. In general the surgical aid centers are from 20 to 25 km. behind the front. Of 850 injured about 753 are brought by auto ambulance to the base hospitals during the first eighteen hours. Skull hematomas, subdural hemorrhages, and middle meningeal hemorrhages are referred to the surgical ambulances for treatment. The surgical ambulances of the army are a definite new aid in the medical section of this army. The surgical field hospital, made possible by the surgical ambulance, is a mobile hospital equipped with all the modern requirements of a surgical clinic. The activity of the surgical ambulance is variable according to the type of war (either mobile warfare or entrenchment). It will, however, be possible to set up the field hospital 25 km. behind the front lines. Skull and brain injuries should be dressed in the first aid stations or on the field with a sterile dressing.

A classification of the head injuries is made. In general, craniocerebral wounds are divided into the following categories: (1) extensive injury of the scalp; (2) penetrating injury of the skull with small external injury; (3) oblique injuries of the skull without dural involvement, but which are often accompanied with subdural hematomas and extensive injury to the brain substance. The oblique injuries are usually extensive injuries as the projectile may injure distant areas of the skull.

At the first aid station the head injury should be cleansed according to all the skill known to medicine. Into the wound a tablet of mercurochrome or sulfanilamide should be placed. After that the wound should be closed with an occlusion bandage. In this condition the patient is placed in the surgical ambulance or brought into a military hospital. The author considers the disinfection of the head wound as extremely important, as the late abscess or infectious encephalitis is the most severe complication that can occur after head injuries. The greatest number of head injuries during the war of 1914 ended fatally from one or the other of these complications.

The surgical ambulance takes care immediately of the severe hemorrhages from head wounds, combats the shock, extracts large foreign bodies, and gives transfusions. Stopping of hemorrhage and the treatment of shock follow definite surgical principles. Of special emphasis is the administration of from 10 to 20 gm. of sodium bicarbonate to prevent acidosis. To relieve intracranial pressure 15 per cent magnesium-sulfate solutions are given and solutions of chloral and bromide.

The author discusses injuries of the brain in great detail. He follows the technique practiced universally in all the armies, the principles of which have been laid down by Vincent, Cushing, Guillaume, Garcin, and others. His method of wound treatment is outlined as follows:

1. Cleansing of the entrance and exit openings of the projectile.

2. Removal of all bony splinters in the wound and débridement of all damaged soft tissues.

3. Actual treatment of the brain injury. This attempts to prevent infection and to ameliorate the existing brain symptoms. Blood clots and other fluids are removed with the suction pump. The

brain wound is irrigated with hydrogen peroxide or Dakin's solution.

4. Hemostasis is painstaking. After thorough cleansing of the wound mercurochrome or sulfanilamide tablets are inserted. Tincture of iodine and alcohol should not be employed.

5. The dura is sutured with a fine needle together with the periosteum.

6. The scalp is sutured in the usual manner. Whether the wound should be closed primarily or drained depends upon the severity of the injury. Definite statements or rules cannot be laid down for this.

Regarding trephining for hematoma the author believes that the ambulance personnel should do this also. This is recommended especially in those cases in which the entrance wound of the projectile is small. In these cases a severe hematoma may develop with extreme compression symptoms. The surgical ambulances are therefore equipped with trephining apparatus.

The removal of superficial foreign bodies should not be attempted by the surgical ambulance personnel as they are not equipped with the necessary diagnostic aids. Blood transfusions in the combating of shock are advised in amounts of from 100 to 150 c.cm., but contraindicated in severe skull injuries. The neurosurgical treatment is not given in the ambulances but should be done by specialists in the stabile base hospitals.

The author gives a review of the necessary instruments and equipment for brain surgery.

(Schweizer). Leo A. Juhnke, M.D.

**Brofeldt, S. A.: Skull Fractures and Their Management** (Ueber die Schaedelbrueche und ihre Behandlung). *Acta Soc. med. Fennicae Duodecim*, 1940, Ser. B., 28: Fasc. 1.

At the Finnish Red Cross hospital from 1932 to 1938, the author had occasion to study 1,076 cases of craniocerebral injuries, among which were 275 skull fractures. They represented injuries from all sorts of sources—sports, everyday life, industrial accidents, and automobile accidents. Sixty-five of the patients with skull fracture (23 per cent) died of brain injury, 60 per cent of the deaths occurring in the first twenty-four hours. Seventeen patients developed meningitis.

Open fractures with access to the brain were opened still further surgically; depressed bone was elevated or removed, the dura was sutured, and the scalp was closed in its anatomical layers. Drainage was not instituted. Severe frontal fractures usually require only conservative treatment, for the outer wall of the frontal sinus may be the only bone which is fractured, and frequently even though there is a large hematoma the actual bone injury may be slight. However, if the frontal sinuses were depressed and the posterior sinus wall was fractured with an exposure of the cerebrum to the sinus cavity, then the sinus was opened widely through the original skin wound, the posterior wall explored, the dura freed and repaired if necessary, and free drainage established from the sinus out through the wound in the skin.

Fractures into the middle cranial fossa are frequently attended by two principal complications: meningitis and damage to the auditory apparatus. The early diagnosis of such a meningitis may be very difficult, and frequent cerebrospinal-fluid analyses are necessary. The organism is usually a pneumococcus or a streptococcus. The use of prophylactic serum in patients with potential meningitis has been found to give "good statistical results."

John Martin, M.D.

**Gaus, W.: Therapy in Acute Osteomyelitis of the Frontal Bone** (Ein Beitrag zur Therapie der akuten Osteomyelitis des Stirnbeines). *Arch. f. Ohren-, Nasen- u. Kehlkopfh.*, 1940, 147: 353.

Suppurative inflammation of the flat cranial bones is particularly dangerous because of the relationship to the cranial cavity. In view of the continuous progress of the illness, radical treatment is necessary. Delayed or semi-delayed treatment as well as x-ray therapy, though effective in isolated instances, is insufficient for the majority of cases. The most radical operation appears entirely justified in view of the fact that new bone formation takes place rapidly, particularly in young individuals. However, it seems desirable to save as much bone as possible, and, if there is no extension of the infection into the cranial cavity, to restrict oneself to decortication, or the removal of the outer layer. For safety's sake the hard cerebral membrane should be laid open in several places. If it shows pathological change, the inner layer should be removed also. The question of possible disfigurement should be secondary in consideration. Coronal section is recommended.

Gaus reports 3 cases of suppurative inflammation of the frontal bone. In 2 instances the patients were children, a girl eight years of age and a boy five years old. The former was brought to the clinic for treatment after a three-day illness, in a state of stupor and with a swelling over the left orbit. The eye itself showed no pathological changes.

The immediate surgical intervention, consisting of a section across the eyebrow, disclosed a focus of pus in the outer portion of the orbit; moreover, an open fistula was seen at the base of the cranial cavity, and this was cleaned out from underneath. On the following day the general condition of the patient was worse and there was evidence of a pasty swelling reaching from the middle of the forehead to the temple. It was necessary to expose the frontal bone more thoroughly by a section reaching medially to the sutura coronalis, and by another transverse section reaching to the upper edge of the ear. Under the osseous membrane a few suppurative foci were found; the diploë showed numerous foci of suppuration, and the same condition prevailed on the hard cerebral membrane; it was necessary to remove the entire bone together with the margin of the orbit.

No sutures were applied. The child recovered quite rapidly. The subsequent considerable shrinkage of the flap made a plastic operation necessary which was rendered difficult on account of the former having grown to the hard cerebral membrane.

In the case of the boy, a swelling on the upper right eyelid appeared eight days before hospitalization. The swelling spread to the left eye in the course of the following days, a pasty swelling appeared within the radius of the left side of the forehead, and the skin took on a blue-red coloring; there was a high temperature and the patient became unconscious. The frontal bone was exposed by a bilateral section which reached across the eyebrows and was joined by a transversal section across the radix nasi. Since during the process of exposure numerous foci were discovered in the intermediary layer, but the inner bone surface and the exposed portions of the hard cerebral membrane were unaffected, the operation was restricted to decortication and the wound surface was filled with gauze strips saturated with cod-liver-oil salve. After two days the boy was fully conscious. Recovery was somewhat delayed by the appearance of an ulceration on the child's back. A considerable shrinkage of the flap made a plastic operation necessary.

The third case was that of a twenty-four-year-old woman who complained of pain starting at the root of the nose and extending over the forehead to the back of the head; the pain had increased steadily over a period of one year and had become unbearable during the last two weeks before admittance to the clinic. There was a swelling at the right and left side of the root of the nose which extended to the hair line and over the right parietal bone. A roentgenogram disclosed a shadow in the right frontal cavity and lighter areas in the frontal and parietal bone. The frontal cavity was exposed by a section across the eyebrow; pus was removed and the thickened membrane cleaned out. The cranial corticum was dissected by a section reaching from ear to ear. Again the removal of the outer layer and cleaning of the middle layer were sufficient, but recovery was retarded by thrombosis of the pelvic veins. Postoperative treatment consisted of the use of gauze strips saturated with "unguentolan" which were placed in the wound cavity through the opening in the eyebrow. Suturing with large quantities of salve in the wound appears too dangerous because of the proximity to the brain.

(Weiss). Hilda H. Wullen.

**Stokes, H. B.: Primary Malignant Tumors of the Temporal Bone; Report of a Case.** *Arch. Otolaryngol.*, 1940, 32: 1023.

Malignant tumors involving the middle-ear cleft and the temporal bone are in no sense pathological curiosities; nevertheless, they are sufficiently rare to present a most perplexing clinical problem. The neoplasms most commonly encountered, in order of frequency, are the squamous-cell carcinomas, the adenocarcinomas, the sarcomas, and the hemangioendotheliomas. The age incidence seems to be much the same as with malignant tumors found in other locations, the growth most often occurring in the middle decades of life, but not necessarily so. For some obscure reason as yet unknown, primary malignant tumors of the ear are very slow to metastasize, even the regional lymph nodes escaping until late in the disease and intracranial extension being the rule.

Nothing pathognomonic can be attached to the early signs and symptoms of these tumors. The malignant disease may in the beginning mimic or supervene on a number of relatively innocent lesions involving those structures associated with the middle-ear cleft and the more serious diseases of the mastoid and petrous portions of the temporal bone. Suspicion should be aroused by one or more of the following clinical phenomena:

1. The presence of tough, resistant granulations or polyps and the rapid recurrence of these when removed by curettage or chemical means;

2. The appearance of a bloody discharge at the external meatus, sometimes spontaneous and at other times preceded by purulent otorrhea;

3. A complaint of persistent, deep-seated, intractable pain about the ear—severe otalgia unexplained by any visible pathological change in the tympanum, the posterior group of paranasal sinuses, the nasopharynx, the teeth, or the larynx;

4. The occurrence of a supposedly commonplace lesion of the external or middle ear which not only becomes refractory to treatment but shows in its inexorable advance a baffling dissimilarity to the usual clinical course and finally produces complications inconsistent as to time and place. A biopsy is the surest way of settling the issue, provided, of course, that gross material exists from which specimens may be taken during the early stages. It must be remembered, however, that histological diagnosis is subject to error; therefore, it still is necessary to enlist the services of a competent neurologist or internist, as the case may demand.

There is no uniformity of opinion or technique in regard to treatment, nor can there be, since the disease, so complex in its ramifications, precludes standardization. According to the best modern authorities, treatment consists of a combination of several methods now in use. Cutaneous incisions should be made, preferably with the diathermy knife, and all soft-tissue excision should be done with a suitable dissecting electrode. Portions of the tumor which for some reason or another cannot be removed should be destroyed with a coagulating current. A radical tympanomastoidectomy through the posterior route (not by the endaural, antauricular approach) is the operation of choice. The removal of bone must be extensive, in order to gain exposure and make access to the tumor as complete as possible. It is inadvisable to make a plastic skin flap; in fact, most writers advise a sleeve resection of the external canal, including the concha and the tragus. Amputation of the entire pinna has not gained

favor. At the conclusion of the operation radium capsules are inserted into the depths of the radical cavity and radium needles implanted subcutaneously around the external ear. Postoperative high-voltage roentgen therapy also is generally recommended.

The author reports a primary malignant tumor of the temporal bone in a woman aged sixty-three.

JOSEPH K. NARAT, M.D.

**Janes, R. M.: The Treatment of Tumors of the Salivary Glands by Radical Excision.** *Canadian M. Ass. J.*, 1940, 43: 554.

The enucleation of parotid, benign, mixed tumors by the usual technique must be regarded as unsatisfactory, since recurrences varying from 15 to 45 per cent have been reported by different observers. Recurrence is variously reported to be due to failure to excise the tumor tissue and its capsule completely, chiefly from fear of injury to the facial nerve, and perhaps fear of development of a salivary fistula. The reported injuries to the facial nerve vary from 4.4 to 16.9 per cent in benign cases, and from 20 to 36.6 per cent in malignant cases. The author points out that if gland tissue is left distal to a divided main salivary duct, a fistula will occur.

Four main theories of the origin of parotid tumors are mentioned: (1) endothelial origin; (2) embryonal origin; (3) branchial origin; and (4) purely epithelial origin from the gland epithelium itself. No single theory explains their origin, according to Ewing. Some authors believe that benign mixed tumors are capable of forming metastases. At any rate, they are likely to recur locally, and if they metastasize they are usually regarded as malignant mixed tumors.

The author developed a method of excision of these tumors, unaware that Sistrunk and Adson had reported a similar method. The incision is the same. His method differs in that he exposes the facial nerve at the stylomastoid foramen before dissecting the tumor free from its attachments, instead of first exposing and tracing the inframandibular branch proximally to the main trunk. The latter method is more difficult, and in Sistrunk's hands resulted in several partial or complete permanent facial paralyses.

The incision in small tumors begins over the base of the mastoid process close to the ear, and is carried downward and forward behind the angle of the jaw for about 3 in. In large tumors, a second incision begins just in front of the pinna of the ear and is carried down to meet the first incision below the ear. The angle of the junction is made obtuse to prevent sloughing of the tip of skin. This incision can be carried downward and forward to permit exposure and ligation of the external carotid artery as a preliminary step in large or malignant tumors. This step reduces bleeding and makes the dissection of the nerve branches easier.

The incision is deepened to expose the tip of the mastoid process and the origin of the digastric muscle. Removal of the tip of the mastoid process often gives easier access to the facial nerve. The tumor is then dissected free from the branches of the nerve as far as possible. In many cases it is necessary to sacrifice all of the divisions except the temporal branch. It is important to save this branch particularly, since it supplies the eye and upper part of the face. Perhaps the only indication for rapid frozen section of tumors which are removable technically is to determine the necessity for complete sacrifice of the facial nerve.

The results of surgery on malignant parotid tumors, from published reports, appear to be unsatisfactory. These tumors should receive pre-operative and postoperative irradiation, and should be radically removed wide of all malignant tissue. Benign mixed tumors are highly radioresistant, and more radical operative procedure is necessary to prevent recurrence.

The author reviews 48 cases appearing in the records of the Toronto General Hospital over a period of ten years, from 1930 to 1940, including 38 benign mixed tumors, 1 chronic inflammatory lesion, and 9 malignant growths. In 12 of the cases the tumor was excised radically according to the technique described, 2 total excisions of the parotid gland being included; in 5 cases paralysis of the mandibular division resulted.

The author concluded that total excision of the parotid gland can be performed without serious injury to the facial nerve.

JOHN E. KIRKPATRICK, M.D.

## EYE

**Ferree, C. E., and Rand, G.: Pilot Fitness, a Safety Factor in Aviation.** *Brit. J. Ophth.*, 1940, 24: 581.

The authors devised an instrument which measures the speed of adjustment of the eyes for change of distance, the speed of accommodation, and the speed of adaptation, and also tests ocular and general fatigue. This instrument is called an electrical multiple exposure tachistoscope, and consists of two near and one far test objects which can be subjected to various positions, time factors, and strengths of illuminations. The instrument is readily portable.

The following practical uses of the instrument and test procedure are discussed: (1) a test of vocational fitness in all cases in which dynamic speed of vision is important with either the oculomotor or the accommodative feature emphasized; (2) a test of pilot fitness for aviation; (3) a specific performance test of fitness for night flying; (4) a test of disturbance in fitness due to altitude; (5) a definite limiting test for age as a factor in fitness; (6) a means of measuring ocular fatigue and recovery, and of testing individual susceptibility to fatigue and capacity to recovery; and (7) a means of training eyes to greater oculomotor and accommodative facility.

The authors particularly emphasize the importance of determining pilot fitness before each flight. They make the pertinent observation that

although a check is made on each plane to see that it is in perfect condition before a flight, little attention is given to the condition of the pilot to see if some temporary disturbance might be present which renders the aviator unfit. Various factors, such as fatigue, loss of sleep, worry, and temporary illness, may be of sufficient effect to cause the pilot to falter at a critical time. By means of a tachistoscope examination requiring perhaps ten minutes these temporary defects can be detected and protection of the plane and its occupants can be afforded.

LUTHER H. WOLFF, M.D.

**Gifford, S. R.: Tendon Transplantation for Paralysis of the External Rectus Muscle; A Further Report.** *Arch. Ophth.*, 1940, 24: 916.

The author says experience with paralysis of the external rectus muscle has led him to the following conclusions:

1. The transplantation of living tendon slips from the superior and inferior rectus muscles offers the best chance of a cosmetic and functional result in paralysis of the external rectus muscle. The outer halves of the muscles were chosen in these cases, and the results, on the whole, were satisfactory.

2. Operation should, as a rule, be accompanied by recession of the internal rectus muscle. In cases with primary deviation of more than 15 degrees a recession of 5 mm. is usually safe.

3. Overeffects are rare and can usually be overcome by replacing the internal rectus muscle.

4. Tenotomy of the internal rectus muscle should be reserved for cases in which there is marked contracture of that muscle.

5. No vertical imbalances or deviations occurred as a result of the operation.

6. The operation should be performed before secondary contracture has occurred. In cases of acquired paralysis if no improvement has occurred after three to six months of observation, and especially if the paralysis is increasing, operation is indicated. In cases of congenital paralysis it may be safely performed between the ages of three and five years.

7. In answer to Bielschowsky's criticism, it may be stated that all the patients except 2 have a useful field of binocular fixation while holding the head straight and do not hold the head in an abnormal position.

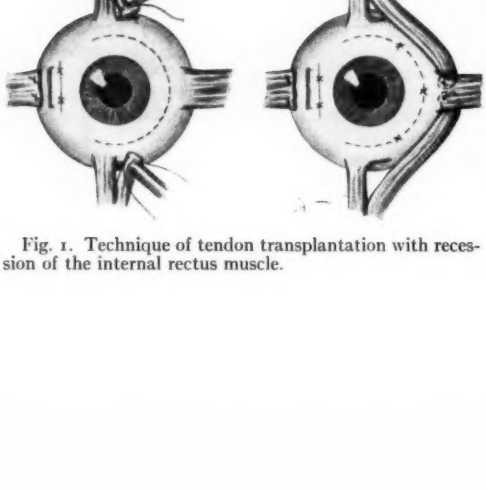


Fig. 1. Technique of tendon transplantation with recession of the internal rectus muscle.

LESLIE L. MCCOY, M.D.

**Davidson, M.: The Evolution of Lens Lesions in Eye Perforations and Ruptures.** *Am. J. Ophth.*, 1940, 23: 1358.

A survey of 62 lens lesions, primarily opacities, observed in cases of eye perforations by intra-ocular foreign bodies and in eye ruptures without retention of the foreign body, indicates that the majority are the result of lens contusion and morphologically belong to the type of contusion lens opacities previously studied. Posterior feathery star-shaped opacities are evidently rare.

Capsule perforation, lens penetration, or its double perforation occur in less than a third of the cases that do not lead to immediate cataract.

The retrospective diagnosis of the eye perforation or rupture origin of a lens opacity is sometimes made difficult because of the eventual blurring of the perforation or rupture character of a corneal scar after many years and particularly because of the difficulty in diagnosing an older partial limbus and scleral perforation or rupture.

The rate of recession into the depth of the lens of originally subscapular opacities is found to vary in this study just as in the study of pure contusion lens opacities. The factors affecting the rate seem to be: capsule lesions, which tend to retard it; varying depth of lens penetration, which would tend to accelerate it; hypertension and siderosis, which tend to retard it; and hypotension, which favors it.

As to the evolution of the lens lesions in this mild variety of cases, the end-results are satisfactory in the majority of cases, but prognosis should be more guarded in the individual after he is thirty years old. Deterioration should be watched for in the fifth decade, when apparently most deteriorations occur.

LESLIE L. MCCOY, M.D.

**Weinberger, L. M., and Webster, J. E.: Visual-Field Defects Associated with Cerebellar Tumors.** *Arch. Ophth.*, 1941, 25: 128.

For the purposes of focal neurological diagnosis, it is generally accepted that defects in the visual field indicate direct involvement of the visual pathways at some point. This is thought to be so true and so dependable that intracranial operations are often planned and performed solely on the information obtained by examination of the visual fields. The great value of perimetric examination has been repeatedly stressed by neurological and ophthalmological writers.

Little, however, has been written on the false clues occasionally furnished by visual-field defects, or, to state it more precisely, by the field defects resulting from the effects of distant lesions on the visual pathways.

Although it is generally believed that field defects indicate direct involvement of the optic pathways by the responsible lesions and that visual-field de-

fects therefore point to the location of the lesion, 8 cases are cited in which various combinations of field defects existed, because of verified cerebellar tumors. In 4 cases there were homonymous defects; in 2 these were homonymous hemianopsias. In 1 there was a bitemporal defect, and in 4 there were various combinations of visual-field defects loosely classified as "atypical." In all but 1 case the diagnosis was confused by these findings and ventriculographic studies were relied on to clarify the diagnosis. In the cases in which ventriculograms were made or autopsy was performed, a marked degree of ventricular distention was found. The third ventricle shared in the general dilatation of the ventricular system.

Though cerebellar tumors are thought not to produce field defects, it has been recognized by many writers that such defects may occur with internal hydrocephalus. Yet every cerebellar tumor eventually results in hydrocephalus. The clinical evidence in the authors' cases also suggests that the distention of the third ventricle resulting from cerebellar tumors is the primary cause for the field defects reported in their 8 cases. While direct compression of the optic chiasm may give rise to bitemporal hemianopsia, the other defects, such as binasal hemianopsia, homonymous hemianopsia, and various unclassified defects, probably depend on notching of the optic nerves and chiasm by the adjacent arteries plus the fact that the chiasm is not always in direct vertical relation with the third ventricle. Thus, many and varied combinations of visual-field defects may follow dilatation of the third ventricle. As a corollary point, the presence of a visual-field defect does not exclude the presence of a cerebellar tumor.

LESLIE L. MCCOY, M.D.

## NOSE AND SINUSES

**Converse, J. M.: Corrective Surgery of the Nasal Tip.** *Ann. Otol., Rhinol. & Laryngol.*, 1940, 49: 895.

During recent years plastic surgery of the external nose has been greatly improved. This is true particularly of corrective operations upon the nasal bones, the lateral cartilages, and the septum. Surgical correction of the tip of the nose is more difficult. It is, however, essential, for deformities of the nasal tip are the most conspicuous of all nasal deformities.

The tip of the nose is constituted by a cartilaginous framework, the alar cartilages, supported by a central pillar, the septum. In the midline the two cartilages meet, supported by the anterior-superior angle of the quadrangular septal cartilage. The alar cartilages then present a sharp turn downward to form the columella. The cartilaginous framework is lined on its inner surface by mucous membrane. It is covered on its outer surface by muscles, subcutaneous tissue, and skin. The muscles which cover the alar cartilages and are inserted upon them are muscles of expression, the nerve supply of which is derived from the facial nerve. Their actions produce dilatation or constriction of the alæ and elevation or depression of the tip.

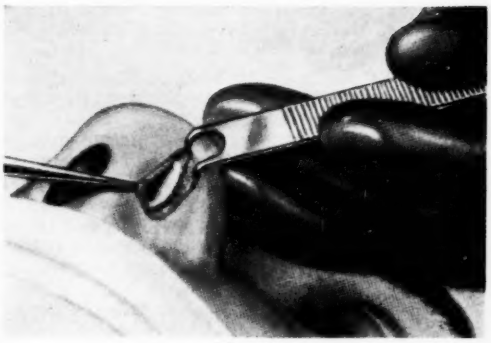


Fig. 1

The shape of the alar cartilages is extremely variable. The variations observed in over 100 operations for tip corrections apply to both the size and the shape of the alar cartilages. Patients with wide hypertrophic tips present thicker alar cartilages than those having thin tips with collapsing alæ. The alar cartilages extend farther laterally into the alæ in the thin type of nose than in the broad type. At times there is a generalized hypertrophy of the alar cartilages in every direction which gives a large bulbous tip.

A surgical approach to the nasal tip must present two essentials: adequate exposure of the cartilages and preservation of the physiology of the region. Adequate exposure of the nasal tip can be obtained by two methods: tip exposure "from above," and tip exposure "from below." In the first method, complete subperichondrial dissection of each alar cartilage is carried out after the exposure of the lower border of the cartilage through an incision near the free border of the nostril. This incision is made along the full length of the cartilage and is carried medially following the curve of the cartilage down the columella in front of the anterior border of the septum. The whole of the cartilaginous tip may then be drawn out through one side or the other.

In the second method, an incision about 1 cm. in length is made along the anterior border of the alar cartilage. A second incision is made along the superior border of the alar cartilage just below the inferior border of the lateral cartilage. The mucous membrane lining the alar cartilage is then elevated along the whole surface of the alar cartilage as far laterally as its free lateral border. A subperichondrial elevation of the muscle layer is performed so that the cartilage is completely separated. The alar cartilage can be seized with a fine hook and drawn out through the vestibular incision.

The author also discusses corrective surgical methods for increase in transverse dimensions, increase in the vertical dimensions of the nasal tip, and deviations of the nasal tip.

NOAH D. FABRICANT, M.D.

**Malbec, E. F.: Fourteen Cases of Partial Rhinoplasty. Marble Prostheses** (Consideraciones sobre catorce casos de rinoplastías parciales. Prótesis de marfil). *Semana méd.*, 1940, 47: 1173.

Fourteen cases of partial rhinoplasty are described in which the author used marble prostheses. There were various deformities of the nose, some of them being cases of extreme saddle nose. Photographs of the patients before and after the operation are given; they show the excellent results of the method, the technique of which is described briefly. In 11 of the cases, or 78.57 per cent, the results were entirely successful, while there was failure in 3 cases, or 21.43 per cent.

There has been a great deal of discussion as to whether living or dead material is to be preferred in such operations. On the basis of his experience the author believes that dead material, such as ivory, is to be preferred. His marble prostheses have been tolerated perfectly. Once they have become adapted to the soft tissues around them they do not change in shape, size, or direction. To be sure, none of his patients was operated on longer than three years ago, so he cannot say definitely whether the results will be permanent, but he sees no reason for any later change. Eitner has reported cases which he has followed up for twenty-five years without change.

On the other hand, living material, such as bone or cartilage, may undergo changes long after the operation, by being absorbed or increasing in size, with disastrous effects on the cosmetic result. The author's cases include some in which a bone prosthesis was used first. The deformity recurred and an ivory prosthesis was then inserted. Roentgenograms showed the thin atrophied layer of bone beneath the ivory prosthesis. AUDREY G. MORGAN, M.D.

## MOUTH

**Grilli, A.: Radium Treatment of More Advanced Forms of Cancer of the Buccal Mucosa** (Il trattamento curieterapico delle forme avanzate di carcinoma della mucosa della guancia). *Radiol. med.*, 1940, 27: 440.

Perussia, Director of the Radiological Institute of the University of Milan, has standardized, for the more recent cases of buccal cancer, a treatment in three stages: (1) the primary tumor is attacked by interstitial implantation of radium needles or by a radium-bearing applicator molded to the inside of the cheek; (2) the regional lymph nodes are radically extirpated; and (3) the region of the lymph nodes is transcutaneously irradiated.

However, the surgeon more frequently has to deal with more advanced tumors. Many patients, being smokers or tobacco-chewers, are accustomed to slight sores in the mouth; and people of poor intelligence do not even care about more evident symptoms. They neglect the cancer until it has grown across the buccal mucosa into neighboring parts and into deeper layers, even to the outer side of the cheek.

In such cases this scheme of treatment is impracticable or inadvisable: the endoral access to the cancer would be partly impossible, the implantation of radium needles might produce too far-reaching destruction and acute septic processes; and the extirpation of metastases in the regional nodes would be dangerously delayed.

Therefore a different method has to be employed for this group. It begins with the external application, on the cheek and region of the lymph nodes, of radium element packs consisting of tubes with from 5 to 20 mgm. of radium, with a 1 mm. platinum filter. The whole region has to be equally irradiated, until the "epidermicidal dose" is reached everywhere within from ten to fifteen days.

After the first stage of irradiation usually the surface of the tumor gets cleaner and smoother. Gradually the infiltration and the rigidity of the cheek are diminished, and the opening of the mouth and the mastication are facilitated; the enlarged nodes shrink and their mobility improves.

If the recession of the tumor goes on fast enough, endoral radium treatment is then given.

If, however, the tumor responds only slowly to the transcutaneous irradiation, the second stage of the treatment should consist of the extirpation of the nodes. After that an edema up to the cheek may be expected, which may interfere with the opening of the mouth and render indistinct the demarcation of the tumor. However, the edema disappears slowly, and the effect of the external irradiation becomes manifest. Now the treatment must be completed by the endoral application of radium.

The author reports on 17 patients with advanced cancer of the cheek. Seven underwent the complete treatment. Four of them proved completely cured after five months, one, two, and six years, respectively. Two had to undergo supplementary irradiation of small parts of the primary tumor; 2 had incurable recurrences; and 1 is yet under observation. Five patients had only two stages of treatment; 2 of these died of cancer, and 1 of postoperative complications; 2 were cured. Of 5 patients who received only one stage of treatment 2 have shown improvement and completion of the cure is expected.

The results of the treatment are very satisfying, when the large extension and the deep infiltration of the tumors in question are considered.

Of course, even this method is not practicable in every case of buccal cancer. Once the tumor has grown too far across the limits of the cheek, has deeply destroyed the jaw bone, or has produced large ulcerations of the skin; if the nodal metastases are too far advanced; or if the patient is cachectic, then the same treatment would inflict damage and compromise the method. NELDA CASSUTO.

## NECK

**Gordon-Taylor, G.: On Carotid Tumors.** *Brit. J. Surg.*, 1940, 28: 163.

Carotid-body tumors occur at ages from six months to seventy-three years but most of the pa-

tients are in the seventh decade. Males are affected in the ratio of 3:2 but in the author's series only 1 of 5 was a female. An injury was recorded in the history of 1 reported case. An aberrant carotid tumor was found at autopsy below the bifurcation in 1 instance. Bilateral tumors are exceptional but have been reported. In some instances a long time interval elapsed between the onset of the 2 tumors. In 1 instance one of the tumors was malignant, the other benign. It appears that 80 per cent of the tumors were benign and that in the reported instances the postoperative recurrence rate was 8.9 per cent.

Examination of the regional lymph glands has shown evidence of infection in some instances. Metastases to the liver and ovary have been recorded. In 1 instance a carotid-body tumor was found in a block dissection for buccal carcinoma. While in the recorded cases the average duration of the tumor was twelve years, in the author's 5 cases the duration was a little more than two years. The average size of the author's cases was 3 by 3.5 in. in the two axes. The tumor is painless, not tender, moves laterally but not vertically. Pulsation is communicated to the tumor by the adjacent vessels. A systolic murmur may be heard but is not common. Syncope and dyspnea may be produced by pressure. It is reported that the tumor is radiosensitive but in 1 of the author's cases the tumor was radioresistant and proved to be a neurinoma.

In the operative treatment the danger of hemiplegia and death in elderly patients is most significant as a result of the occlusion of the common carotid artery and its branches. The author details 3 cases in which the tumor was accurately dissected away from the vessels. In a fourth case a neurinoma was removed from the vicinity of the bifurcation. In a fifth case death followed excision of the tumor with ligation of the vessels. The author asserts that even when the arteries appear almost imbedded in the growth, meticulous care and painstaking dissection may sometimes reveal a "white line" whereby the continuity of the main arterial vessels may remain undisturbed or at least structurally inviolate.

The vague, sympathetic, and hypoglossal nerves may be involved and have to be resected. Changes in the larynx follow vagus resection, while pupil and eye changes occur following sympathetic resection.

Resection of the tumor when still small, before encroachment on adjacent structures, will improve the prognosis. Tumors not originating in the carotid gland but located at the bifurcation make accurate pre-operative diagnosis not always possible. The part played by afferent nerves from the carotid sinus in the regulation of blood pressure are of no particular surgical significance.

MANUEL E. LICHTENSTEIN, M.D.

**Lahey, F. H., Hare, H. F., and Warren, S.: Carcinoma of the Thyroid.** *Ann. Surg.*, 1940, 112: 977.

The authors present a historical review of cancer of the thyroid, and point out the relationship of malignancy to pre-existing adenomas of the thyroid gland. Four illustrative case reports are given, which demonstrate the penalty of delay in the removal of discrete adenomas, and stress the necessity for their early removal as a prophylactic measure.

In the clinical diagnosis of malignancy of the thyroid, thyroiditis must be differentiated. The outstanding feature of this disease is that while the gland may become stony hard, its symmetry and anatomical outline remain in general unchanged. In contradistinction to this, malignancy of the thyroid arises locally with resultant loss of symmetry; firmness in the palpated lesion occurs only when the disease is well advanced, and the adjacent cervical lymph nodes are usually enlarged. Malignant degeneration of an adenoma of the thyroid is suggested by a gradual painless change in consistency from one of firmness to one of induration (as contrasted to hemorrhage into an adenoma, which occurs rapidly and is associated with pain and tenderness); loss of a sharply defined outline with diffusion of the tumor mass into the parenchyma of the gland; fixation of previously movable tumors to the surrounding structures; and, at the time of operation, firm attachment of the prethyroid muscles to the tumor. Recurrent laryngeal paralysis has but little value as a diagnostic sign. Malignant degeneration may occur in a very small thyroid adenoma, and in young patients.

The potential malignancy of lateral aberrant thyroid masses should be recognized, and when they exist, complete dissection of both sides of the neck together with wide removal of any tumors within the thyroid gland itself, is necessary. These bodies should not be confused with metastatic nodules in the lymph nodes.

The most satisfactory management of thyroid malignancy is by means of a combination of radiation and surgery. Surgery is most satisfactory in the prophylactic removal of benign tumors, next in tumors in which the malignancy is intracapsular, next in tumors in which erosion of the capsule has involved the parenchyma at only one point, and least in cases with wide infiltration of the muscle, trachea, and lymph nodes by the growth.

Even in advanced thyroid malignancies, a biopsy specimen should be obtained, since the degree of radiosensitivity varies greatly with the different types of thyroid carcinoma. Seemingly hopeless cases have become discrete, movable, and removable after radiation. The type of tumor will determine how much surgery, as well as how much radiation, to apply. One should not be any more radical than is necessary, to remove the malignancy completely. If complete surgical removal is impossible, removal may still be attempted in order to leave less to the irradiation to accomplish, and often to relieve respiratory obstruction.

If radical surgical removal of an extensive unilateral carcinoma of the thyroid is attempted, the entire lobe of the gland with its contained malignancy and the internal jugular vein and its tribu-

taries attached to it, the sternomastoid muscle, and, if necessary, the recurrent nerve, must be dissected out. The removal of the internal jugular vein is of great importance because of the fact that thyroid malignancy tends to extend into the veins and along their course. It is unwise to continue attempting to remove malignant thyroids unless the dissections can be carried along definite anatomical lines of cleavage. It is particularly hazardous to attempt to remove mediastinal extensions, since there is danger of hemorrhage and infection. Damage to an adherent esophagus must be avoided. If the patient's breathing is hampered or if extensive dissections of the trachea have been done, tracheotomy should be performed at the time of operation.

The following pathological grouping of malignant tumors of the thyroid is given, and their histopathology is described and illustrated by photomicrographs. Group I includes tumors of low or potential malignancy: adenomas with blood-vessel invasion and papillary cystadenomas with blood-vessel invasion originating from thyroid and aberrant thyroid glands. Group II includes tumors of moderate malignancy: papillary, alveolar, and Huerthle-cell adenocarcinomas. Group III includes tumors of high malignancy: small-cell carcinomas or carcinomas simplex (compact and diffuse types), giant-cell carcinomas, epidermoid carcinomas, fibrosarcomas, and lymphomas.

The writers believe that every case of thyroid cancer should be given radiation therapy, even though the tumor is of low and potential malignancy. In the tumors of moderate and high malignancy, most of the good results from radiation come when as much of the tumor has been removed surgically as possible. The end-results depend upon radiation therapy being given in large protracted doses to destroy the tumor completely. Radiation treatment is started usually within one week after the surgical operation, and does not interfere with wound healing. A cross-fire method of radiation is preferable, one treatment being given daily to each of three portals, one portal on each side of the neck and one in the midline, and care must be taken not to overlap the fields. A total dose of 6,000 roentgen units is delivered to the skin during one series of treatments. The complications of radiation treatment are radiation sickness, which usually clears within seventy-two hours after radiation has been completed; radiation dermatitis, which may require six to eight weeks to heal; and laryngitis and tracheitis, which disappear in from nine to ten weeks.

In this series of 231 cases of carcinoma of the thyroid, the five-year survival rate following combined radiation and surgical treatment was: adenoma with blood-vessel invasion, 71 per cent; malignant papillary cystadenoma, 62 per cent; papillary adenocarcinoma, 80 per cent; alveolar adenocarcinoma, 27 per cent; small cell carcinoma, 22 per cent; giant-cell carcinoma, 17 per cent; and fibrosarcoma, 33 per cent.

S. Lloyd Teitelman, M.D.

**Salinger, S.: Radiation Therapy for Carcinoma of the Larynx; Observations After Twenty Years.** *Arch. Otolaryngol.*, 1940, 32: 887.

Salinger's experiences with radiation therapy for carcinoma of the larynx are sufficiently interesting to warrant reading of the original. In brief, however, the author finds no evidence in the record that intrinsic lesions do better with irradiation than with laryngofissure or laryngectomy except when certain constitutional conditions exist as definite contraindications to operative treatment. As for extrinsic lesions which are beyond surgical intervention, one would have to determine from the extent of the lesion, the general condition of the patient, and the histological picture, whether it is worth while to take the risk of full doses of gamma rays in the hope of a cure, assuming thereby the risk of chondritis, necrosis, and the long convalescent period, or whether it is better to administer moderate amounts of the gamma rays for palliation only. With continued experience and changes in technique it may be possible at some time in the future to carry a patient through a full course of irradiation without any danger of adding to his suffering, but at present the risk is still there and should not be minimized. As for the borderline lesions, Salinger believes that, since postoperative irradiation is tolerated better than postirradiation surgical treatment, the patient should be operated upon provided his general condition is satisfactory, and then should be given an adequate course of irradiation, since the results from irradiation alone are to date not sufficiently impressive to offer the patient any greater hope of cure than is offered by surgical intervention.

Finally, the following points are emphasized by the author:

1. No patient should ever be subjected to either operation or irradiation without a preliminary biopsy. Jackson has stressed this over and over.

2. The best results will be obtained only when the laryngologist, the radiotherapeutist, and the pathologist coöperate to the fullest extent, without prejudice.

The patient is entitled to the best that all physicians have to offer, and when a prognosis is given in a particular case it should be based on the combined experience of the best observers and applied as closely as possible to the situation under consideration. Under no circumstances should a patient be misled by the wishful thinking of his physician, nor should he be permitted to make his decision without a full knowledge of what the available therapeutic agents have accomplished in the past.

Noah D. Fabricant, M.D.

# SURGERY OF THE NERVOUS SYSTEM

## BRAIN AND ITS COVERINGS; CRANIAL NERVES

**Pickles, W.: Head Injuries.** *New England J. Med.*, 1941, 224: 139.

From an analysis of a series of 554 patients with craniocerebral injury, Pickles concludes that the treatment of such injuries resolves itself essentially into the treatment of injury to the brain. Such injury, varying widely, may be divided clinically into (1) concussion (momentary loss of consciousness, no neurological signs, normal lumbar-puncture findings, 4 per cent); (2) congestion (concussion plus headache, nausea, vertigo, vomiting, confusion, loss of memory, normal cerebrospinal fluid under increased pressure, 47 per cent); (3) contusion (congestion plus gross injury of the brain of varying degrees, producing shock, convulsions, delirium, shifting signs of localization, and a bloody cerebrospinal fluid under increased pressure, 49 per cent).

Treatment consists of such measures as will abolish shock and restore a normal intracranial pressure. Scalp wounds are given careful surgical cleansing and repair. Depressed, comminuted fractures require a prolonged and careful toilet with meticulous débridement and generous irrigation with warm saline solution. Extradural and subdural hematomas also require early surgical care, the author's treatment being the standard one in such cases. Drugs are used sparingly, morphine not at all. Lumbar punctures may be done carefully and repeatedly, as often as every six hours if need be, until the cerebrospinal fluid is clear. Intravenous dehydrating agents are used in moderation. Subtemporal decompression is rarely resorted to.

The author's operative incidence is 6 per cent; his operative mortality is 29 per cent and his gross mortality is something less than 5 per cent.

JOHN MARTIN, M.D.

**Eckhoff, N. L.: Actinomycosis of the Central Nervous System; Report of 2 Cases.** *Lancet*, 1941, 240:7.

Actinomycosis, rare in the central nervous system, may arrive in such location by (1) spread along the perineural sheaths of the olfactory nerves to the region of the olfactory bulbs; (2) spread by way of the blood stream, as from a lung granuloma, to form a metastatic brain abscess or a meningitis; (3) direct spread in the connective tissues of the face and jaws through the various foramina at the base of the skull.

Two cases are reported, the intracranial actinomycotic lesions arising by means of the third named route. Both patients were males and both suffered a primary cervicofacial actinomycosis; one man showed evidence of additional spread of the lesion from an extracranial site through necrotic bone of the calvarium. Both patients died of intracranial actinomycotic abscesses. The author suggests the use of chemotherapy when the nature of the infection is diagnosed early.

JOHN MARTIN, M.D.

**Piquet, J.: Roentgen Examination of Brain Abscesses** (L'exploration radiologique des abscès encéphaliques). *Presse méd.*, Par., 1940, 48: 1019.

The usual method of roentgen examination of brain abscesses is to remove from 2 to 5 c.cm. of pus and immediately afterward inject the same amount of opaque liquid—lipiodol or 20 per cent iodipin. The advantages of roentgen examination are that the opaque fluid penetrates any extensions or diverticula of the abscess and gives important information in regard to the depth of the abscess and consequently in regard to operation. Very large deep abscesses cannot simply be drained, but require extensive resection of the brain substance.

The injection of opaque substance into the brain, however, is not free of danger. The friable walls of the abscess may be broken and the ventricle infected. The production of iodism and embolism from the injection of iodipin have also been reported.

The author has a personal method which he thinks obviates the danger. He does not inject the opaque substance immediately after the evacuation of the pus but waits for several days until the formation of connective tissue strengthens the wall so there is little or no danger of rupture. Then, instead of injecting the fluid he inserts into the cavity strips of gauze impregnated with lipiodol. In this way the brain substance with a tendency to herniate into the abscess cavity is pushed back into its normal place. When the principal cavity has been filled in this way a little of the contrast solution flows into the diverticula and outlines them faintly. In this way the approximate size of a secondary cavity can be determined. Forty-eight hours later when the dressing

Fig. 1. Cerebellar abscess.

is changed, the secondary cavity can be packed also and its exact boundaries determined. Figure 1 shows how clearly this method reveals the depth of a cerebellar abscess.

Some writers claim that the injection of opaque substance even furthers cure. The author thinks this is going too far, however. Moreover, roentgen examination is not indicated in all cases, as, for example, in brain abscesses in children in which the encephalitis quickly fills the cavity and the suppuration stops in a few days. Also, roentgen examination may fail in cases in which the secondary cavity is not connected with the first.

The author believes that roentgen examination made at least eight days after the removal of pus, by means of packing the cavity with lipiodolized gauze, is harmless and may show anatomical details that are valuable in the choice of treatment.

AUDREY G. MORGAN, M.D.

**Galletto, G.: Experimental Studies on Cerebral Arteriography** (Studi sperimentali di arteriografia cerebrale). *Radiol. med.*, 1940, 27: 905.

Moniz in 1927 was the first to use arteriography in studying the cerebral blood vessels. Arteriography is of particular importance to neurosurgery in aiding the localization of brain tumors. There are other practical applications, such as in: (1) neurological diagnosis in cranial injuries; (2) studies of circulatory disturbances in the brain and of its collateral circulation in health and disease; (3) the study of the cerebral vessels in intracranial hypertension in vascular diseases; and (4) the study of the velocity of the cerebral circulation. In addition it has been used to study the dynamic cerebral anatomy, in contrast to the usual static anatomical studies made at autopsy.

The author performed the present series of studies on the cadaver. He injected thorotrast into the vertebral artery at its origin near the subclavian artery with a special pressure apparatus made with a rubber bulb. The subdural spaces and the lateral ventricles were injected by suboccipital puncture and by puncture of the lateral ventricles according to the technique of Dandy. Likewise the internal and external carotid arteries were injected. After the injections roentgenograms were made in the anteroposterior, lateral, and submentovertical positions with the use of a Potter Bucky diaphragm.

In the first 3 cadavers the author used 50 per cent sodium iodide. He found that using only one internal carotid artery for injection was inadequate. The posterior fossa was best visualized by injecting the internal carotid and the vertebral artery on the same side.

In the second series of cadavers (Nos. 4 to 8) thorotrast was injected under pressure (from 150 to 200 mm.). It was found that injection of the internal carotid and the vertebral arteries on the same side gave the most satisfactory results.

In the third series of cadavers (Nos. 9 to 16) iodipin (Merck) was used as a contrast medium and subdural as well as lateroventricle injections were performed.

It was found that the thorotrast injections gave better results than iodipin [Fig. 1 (thorotrast) Fig. 3 (iodipin)]. The studies also showed the possibility of filling all of the blood vessels in both cerebral hemispheres by the injection of the internal carotid and the vertebral arteries on the same side. The greatest contrast and clarity was obtained with the injection of air into the subdural space (Figs. 1, 2, and 3). Figure 4 represents the first attempt to inject a liquid contrast medium into the vertebral space in order to demonstrate the cerebral convolutions. In the fourth series all the submentovertical views were united in order to study the vertebral arteries, the basilar trunk, and the circle of Willis (Figs. 5 and 6).

In summarizing, the author notes that the sodium iodide tends to diffuse outside of the vessels and obscure the clarity of the films; that it is best to inject the internal carotid and the vertebral arteries on the same side to get the best visualization of the cerebral circulation; that thorotrast also tends to diffuse, but this tendency is corrected by the addition of gum arabic; and that water injected into the vertebral space aids in the contrast. He also used umbrathor (a less expensive modification of thoro-

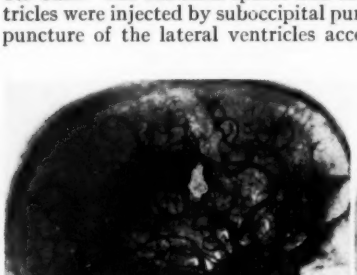


Fig. 1.

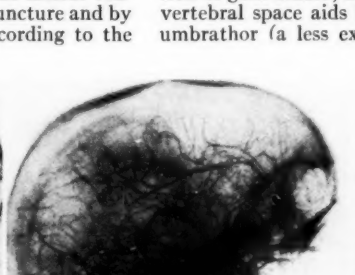


Fig. 2.

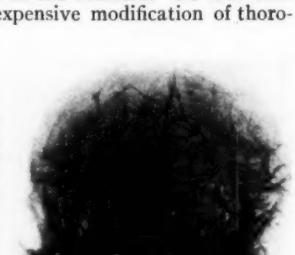


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

trast) in dilutions of 1 to 3 for injection into the lateral ventricles by the technique of Dandy.

JACOB E. KLEIN, M.D.

**Weinberger, L. M., Adler, F. H., and Grant, F. C.: Primary Pituitary Adenoma and the Syndrome of the Cavernous Sinus; A Clinical and Anatomical Study.** *Arch. Ophth.*, 1940, 24: 1197.

Fourteen cases of primary pituitary adenoma are described which presented unusual neurological and neuro-ophthalmological clinical pictures. They were divided into three groups: (1) those in which the disturbances referable to the ocular and trigeminal nerves comprised the exclusive neurological picture; (2) those in which the symptoms referable to the ocular and trigeminal nerves dominated the clinical picture, but in which there were some evidences of implication of the optic chiasm; and (3) those in which the disturbances referable to the ocular and trigeminal nerves were an important part of the clinical symptoms, but in which there were unequivocal visual field defects indicating an intrasellar lesion.

The disturbances referable to the ocular and trigeminal nerves in these cases were accounted for by the implication of the cavernous sinus. It was shown that occasionally pituitary adenomas grow laterally and that this mode of growth may produce the clinical picture of a lesion in the sphenoid fissure rather than the classic chiasmal syndrome.

In addition to the aggregation of signs and symptoms pointing to implication of the structures contained in the cavernous sinus, the cases reported by the authors presented two fairly constant characteristics: (1) evidence of dysendocrinism, and (2) roentgen evidence of an intrasellar lesion.

The anatomical structure of the sella turcica and its surroundings, which results in the lateral growth of the tumors with involvement of the structures contained in the cavernous sinus, is discussed by the authors.

The conditions to be differentiated are: (1) suprasellar tumor; (2) aneurysm of the internal carotid artery; (3) meningioma of the lesser wing of the sphenoid bone; (4) nasopharyngeal carcinoma with extension through the base of the skull; (5) tumor of the gasserian ganglion; (6) sarcoma of the sphenoid bone; (7) orbital tumor; (8) syphilis and syphilitic arachnoiditis; and last, though not least, (9) suppurative sphenoiditis associated with periostitis of the sphenoid fissure.

It is now the generally accepted principle always to approach the pituitary adenoma from the right side when transfrontal craniotomy is performed. This procedure is adopted because it is technically much easier for a right-handed operator to approach from the right. Another consideration is the avoidance of the left-sided speech centers. This is especially important if it becomes necessary to resect the frontal lobe to gain exposure of the tumor. It appears that this justifiable standardization of technique requires amendment in the cases of tumor that present the syndrome of the cavernous sinus on the left side. According to the operative findings in the cases reported here and the necropsy observations, the approach must be from the side presenting the disturbances referable to the ocular and trigeminal nerves if relief is to be obtained. Since these tumors may occupy and infiltrate the cavernous sinus, extreme care must be taken to avoid tearing of the sinus, with resultant uncontrollable hemorrhage.

Radiation seems to have a fairly good effect in relieving symptoms referred to involvement of the nerves contained in the cavernous sinus. If, however, roentgen therapy rather than surgical intervention is used as the initial attack on a pituitary adenoma and it is unsuccessful, the tumor may spread widely and thus make a surgical attack difficult and hopeless if occasion demands it later on.

JOSEPH K. NARAT, M.D.

**Jakob, C., Prini, I., Riedel, C., and Thénon, J.: Painful Spastic Paraplegia by Compression of the Inferior Dorsal Medulla from Dural Endothelioma Psammomatosa** (Paraplejía dolorosa espástica por compresión de médula dorsal inferior por endotelioma psamomatoso dural). *Semana méd.*, 1940, 47: 1387.

The authors indicate the rarity of the localization of psammoma in the spinal dura mater. For that reason they report in detail a clinical case with suitable illustrations.

The patient was a fifty-three-year-old female with a family history of a tendency toward melancholia and kyphoscoliosis in the female half of the family tree. The first symptom of the present illness occurred in 1938, with girdle pains and pains in the right hip. These pains were intermittent in nature and began usually in the mornings. By the beginning of the next year involuntary contractions of the extremities had developed which were much worse at night. In April, 1939, a feeling of coldness had developed in both legs. By October the symptoms had become worse and were spreading up the body. By November there was a sense of constriction about the level of the umbilicus and also some pain. Then a frank paraplegia developed which was worse on the right side. This was a painful spastic paraplegia. Then there occurred incontinence of the sphincters. In April, 1940, the patient was bedridden in a position of dorsal decubitus. There was persistent constipation with tenesmus and incontinence of the anal and vesical sphincters. Pressure over the eighth, ninth, and tenth dorsal vertebræ caused pain. Active motion was completely gone in the right leg and very much diminished in the left leg. There was diminished tone of the muscles in the postero-external aspect of the legs with atrophy of the muscles. There was hypo-excitability of the galvanic and faradic response without a reaction of degeneration.

Knee reflexes were exaggerated on both sides; the Achilles reflexes were diminished. The abdominal and femoral reflexes were energetic. Abdominal cutaneous reflexes were abolished on the right side. The Babinski plantar reflexes were positive on both sides; the Gordon, Oppenheim, and Schaeffer reflexes were positive. Pilomotor reflexes were abolished except in a small area on the superior external third of the thigh.

Tactile sensation was normal but pain sensations were preserved (hyperesthesia on the dorsum of both feet). Thermal sensations were diminished below the level of the umbilicus. Thermal anesthesia was present in the femorocutaneous region, and in the dorsum and plantar regions of the feet. In a few isolated spots heat caused an intense sensation of cold. There was a loss of deep sensibility.

X-ray studies revealed a diminution in size of the eighth, ninth, and tenth vertebral bodies. Ascending lipiodol injection was stopped at the superior border of the tenth vertebra. Lumbar puncture showed increased pressure (25 in the sitting position); the cell count was 257 with 22 per cent polymorphonuclear leucocytes; the albumin 0.25 o/oo; glucose, 0.76 per mil.; and the chlorides 7.07 o/oo; the Pandy test was positive; the Wassermann and Kahn tests were negative. The red blood count was 3,470,000; the white blood count, 11,800; neutrophiles, 67 per cent; basophiles, 0.50 per cent, eosinophils, 1.50 per cent; lymphocytes, 28 per cent; and the large mononuclears, 2 per cent. The Mantoux test was positive. The general condition was excellent with a slight loss of weight. The diagnosis was spastic paraplegia due to compression of the medulla at the level of the eighth, ninth, and tenth dorsal vertebræ, the Brown-Séquard syndrome.

On April 29, 1940, the patient was surgically treated under cyclopropane anesthesia. A laminectomy of the seventh to the eleventh dorsal vertebræ was performed. The dura mater was under great tension. At the level of the ninth dorsal vertebra the dura mater was considerably reddened and thickened. The dura mater was incised for 6 cm.; a pea-sized tumor was found compressing the medulla. This was excised. An encrusted area with a tendency to bleed was found in the dura mater in which the tumor was embedded.

One month after the operation the painful contractions had diminished considerably. The patient slept from five to six hours a night; the girdle sensation was much ameliorated, and the sphincter control was normal. The reflexes and sensibility had also markedly improved. Biopsy revealed a typical endothelioma with numerous psammomatous bodies. The pathogenesis included the following: (a) primary period—latent endothelial arachnoidal plaque; (b) second period—endothelial proliferation with subdural adhesions; (c) third period—vascularization and transformation into neo-endothelioma; (d) fourth period—the formation of psammomatous bodies. Two months after operation there was marked improvement; however, the patient was still ataxic and walked with the aid of crutches.

JACOB E. KLEIN, M.D.

**Schwartz, C. W.: The Cranial and Intracranial Epidermoidomas, From a Roentgenological Viewpoint.** *Am. J. Roentgenol.*, 1941, 45: 18.

The epidermoid tumors are relatively benign although on rare occasions they may undergo malignant degeneration.

They are covered by layers simulating the skin of an onion and giving a lustrous pearly sheen. King described three such layers: an outer, consisting chiefly of acellular connective tissue; a middle, composed of stratified squamous epithelium; and an inner, formed of cornified epithelium. On the other hand, Baily found four layers, the stratum durum, granulosum, fibrosum, and cellulosum. The central and major portion of the tumor consists of epithelial débris with cholesterin, from which comes the frequent designation of cholesteatoma.

The epidermoid tumors originate from groups of cells which may be thought of as ectodermal rests. Once started on their career, they grow very slowly,

but because they produce no symptoms they may reach a considerable size before they are discovered.

The incidence of cranial and intracranial epidermoids varies between 0.13 and 0.6 per cent, but those found in the middle ear are not included in this estimation. Jefferson and Smalley collected 179 cases of epidermoid growths from the literature and they were distributed as follows:

| Type or Location of Tumor | No. |
|---|---|
| Parapontine | 63 |
| Parapituitary | 49 |
| Fourth ventricle | 21 |
| Lateral ventricle | 6 |
| Diploic | 30 |
| Pineal | 1 |
| Suprasellar | 1 |
| Intraspinal | 8 |

The diagnosis of the cranial and intracranial epidermoid tumors is based on the long, slowly progressive history and on the clinical findings.

If the tumor is localized to the fourth ventricle, there is evidence of generally increased intracranial pressure and, perhaps, of posterior displacement of the pineal gland despite the fact that the tumor is subtentorial. If there is calcium deposit present, roentgenography reveals shell-like shadows forming the outer portion of the tumor mass. It must be remembered, however, that below the tentorium a calcified shadow may also be the result of an astrocytoma, ependymoma, or tuberculoma, or even of aneurysm.

If the tumor is in the choroid plexus of a lateral ventricle, it is apt to involve the glomus; again, this tumor may often contain deposits of calcium and differentiation become very difficult. An encephalogram may occasionally help.

It is in the diploë that the epidermoid tumors are most readily diagnosed, because of the defects which they produce in the skull bones. Whether they are situated extracranially, intradiploic, or intracranially, but extradurally, the osseous defects appear on the roentgenograms as more or less irregular areas of rarefaction resulting from pressure atrophy. The margins of the areas are serrated or fairly regular, usually the former, and often are surrounded by a dense bony ring which can be felt by the palpating finger and is almost pathognomonic. In and about the frontal sinuses, and at the base of the skull, the ring may be absent and thus the diagnosis rendered more difficult.

As indicated in the above compilation of Jefferson and Smiley, about 40 per cent of the intracranial epidermoids occur along the brain stem, and perhaps extend into the cerebellopontine angle. Unless they have eroded the adjacent bones or have become calcified, tumors in such locations may well go unrecognized on the roentgenogram.

A great deal of contradictory discussion exists concerning the origin and nature of the epidermoids in or near the middle ear and its adnexa. The commonly found, foul-smelling tumefactions, especially if associated with a chronic infection, must undoubtedly be classified as cholesteatomas, but occasional epidermoids may occur. In this respect an antrum which is larger unilaterally than the usual 6 or 8 by 10 mm. must be regarded with suspicion. On the other hand, an epidermoid located in the petrous pyramid may be recognized on the roentgenogram by the presence of an area of rarefaction in or near the mastoid antrum, and occasionally the mastoid emissary vein may appear enlarged as compared to the opposite side.

Fig. 1. Epidermoid cyst of the right parietal bone showing the typical well defined margin of the bone defect. This tumor was confined to the diploë.

All in all, it seems that roentgen studies have a definite value in the diagnosis of most of these tumors. It is quite possible that planigraphy may lead to further additional information.

A bibliography of 71 articles is appended.

T. Leucutia, M.D.

**Sprockhoff, H.: Postoperative Conditions of Lowered Intracranial Pressure in Brain Operations. A Contribution to the Pathological Physiology of the Cerebrospinal Fluid System** (Postoperative Zustaende von Erniedrigung des Schaedelinnendrucks bei Hirnoperierten. Beitrag zur Pathophysiologie des Liquorsystems). *Nervenarzt*, 1940, 13: 341.

A pathological lowering of the intracranial pressure was observed in 11 patients following a craniotomy for space-occupying lesions or late traumatic epilepsy. Two had infratentorial, the others supratentorial skull defects. These, however, were

significant in only 2 of the latter, in the others they were only on the edge of an osteoplastic flap. If the defect is large enough it is drawn strongly inward in hypotension and permits no pulsation of the brain beneath the flap of soft parts. At first the patients complain of headache and they are restless and irritable; then they become apathetic, their senses become clouded, and they have a slight stiffness of the neck, nausea, slight fever, and perhaps pallor of the face. The picture can progress to a deeper loss of consciousness with fixed pupils, and, finally, to a comatose state with Cheyne-Stokes respiration. Diagnosis in the absence of a defect depends on puncture.

The therapy consists of the intralumbar injection of physiological saline to abate the acute danger, and giving a large amount of fluid by mouth or intravenous injections of isotonic or hypotonic saline or glucose solutions to restore the normal pressure, and caffeine for regulation of the cerebral blood flow which increases the production of fluid by the choroid plexus. An upright position should not be permitted.

From the lability of the condition Sprockhoff concluded that the essence of the complication is not in the lack of a definite amount of fluid alone, but that there is a disturbance of the dynamic equilibrium of fluid formation and absorption, i.e., a disturbance of the plexus. Therefore, punctures for the injection or removal of fluid should be made as seldom as possible in order not to delay the stabilization of pressure relationships.

Two cases are presented which illustrate these points in a more detailed manner, and the author discusses similar symptoms, e.g., headache, after lumbar puncture, in cases of chronic hypotension difficulty in skull defects, in old atrophic brains (according to Monakow), after energetic deep x-ray treatment of the skull (damaging the plexus), and in diffuse atrophy of the brain due to severe skull trauma.

Perhaps the kind of tumor (meningioma) or the location of the tumor has an influence on the origin of postoperative hypotension. The "hematoma ex vacno" in "ventricular collapse" after operation for hydrocephalus also has its basis in disturbance of the stability of the plexus. Factors of hypotension likewise play a rôle in the origin of the pachymeningitis hemorrhagica of older people in a similar manner.

Finally, in regard to drugs, perhaps quinine exerts a membrane-closing action on the cells of the plexus. However, postoperative circulatory disturbances are never the cause of severe hypotension phenomena, although conceivably they cause a general dehydration of the body. Chloride depletion is of no decisive significance. However, the dehydration treatment should not be used schematically.

The underlying factors which lead to atrophy of the plexus—the favoring circumstances—the method of abolishing the lowering of the fluid pressure, prophylaxis, and therapy are presented by the author in a very interesting diagram at the conclusion.

(Goebel). Edward W. Gibbs, M.D.

## SPINAL CORD AND ITS COVERINGS

**Lee, F. C.: An Osteoplastic Neurolysis Operation for the Cure of Meralgia Paresthetica.** *Ann. Surg.*, 1941, 113: 85.

The ideal treatment of meralgia paresthetica would be one which not only relieves the pain in the thigh but which also restores normal cutaneous sensibility to the painful area. Failures in the past have occurred following resection of the lateral femoral cutaneous nerve because of the formation of a neuroma at the site of nerve section, or because resection was done too far distally to the inguinal ligament. Mistaken diagnosis, also, has produced failures.

Simple neurolysis of the lateral femoral cutaneous nerve may be adequate in some patients, particularly if they have a thick layer of subcutaneous fat, but in many persons the old pain will soon recur after such a simple procedure because of new scar formation about the nerve.

Because of complete success in 2 patients with a new technique, the author presents his rather unique operation. The inguinal ligament is cut, the nerve is freed out of its old bed, and is surrounded if possible by a pedicle of fat. A slot is cut in the ilium 1 in. posterior to the anterior superior spine, and in this slot the nerve, free and relaxed, is placed. The inguinal ligament is repaired with interrupted silk sutures. The wound is closed in anatomical layers.

Hernia does not result from such a section and immediate suture of the inguinal ligament, and a two-year cure, plus x-ray films which show no filling in of the slot, indicate that compression of the nerve by secondary bone growth in the slot is not a complication to be expected. John Martin, M.D.

## PERIPHERAL NERVES

**Bayer, W.: Peroneus Injury Due to Trauma of the Knee-Joint Ligament** (Zur Peroneusschaedigung durch Aussenband-verletzung des Kniegelenks). *Zentralbl. f. Chir.*, 1940, p. 1672.

The number of injuries involving the motor nerve trunks of the limbs is increasing as a result of sport, traffic, and industrial accidents. Among the patients of Hohenlychen there were, between the years 1934 and 1939, exclusive of war wounds, 16 with injury of the cervical plexus, 12 with injury of the ulnar nerve, and 17 with injury of the peroneal nerve. The last nerve, which is the only peripheral motor nerve, runs extensively immediately under the skin, in proximity to the head of the fibula and in front of the collateral ligament of the fibula and the arcuate popliteal ligament. An injury to the ligament therefore necessarily affects also the peroneal muscle. However, the seriousness of the injury to the ligament does not always correspond to the severity of the injury to the peroneus.

In 9 serious lacerations of the ligament, of the entire outer fascia and muscle columns, the nerve was often stained with blood within a circumference of

from 10 to 12 cm., or it had grown corneous and was partly lifted from its base. Nervous manifestations appeared in such cases immediately after the accident. Eight injuries to the peroneus became evident only after weeks, even months. Usually, these symptoms were no longer considered a result of the accident. In some cases they were erroneously classified as "abortive types of infantile paralysis." However, the absence of general clinical signs in the case history, the circumscribed local paralysis without proliferation of the fatty tissue, without extensive trophoneurosis and with atrophy of the adjacent muscles, point against infantile paralysis and to accidental injury. Inward shaking of the knee joint, open outer joint fissure, atrophy of the outer upper thigh muscles, and pain caused by putting weight on the joint prove the connection between peroneal injury and trauma of the ligament.

Treatment of these late injuries must eliminate the strangulation of the nerve. The leg is therefore immobilized in a plaster cast with medium posture of the joint. Gentle shaking to stimulate the nerve and an attempt to induce better blood circulation almost invariably result in improvement. If conservative treatment fails, or if there is evidence of a serious ligament-nerve injury, surgical intervention is indicated. A plain ligament suture is not sufficient. By displacement of the tip of the musculus vastus the latter is strengthened. In some special cases another silk thread is put through the tendon and muscle, according to Gebhardt-Schulze's method. The nerve is loosened from its corneous strangulation and placed outside of its cicatricial covering. If this proves to be impossible, a support of fatty fascia is used. With the help of this method 3 patients with peroneal injuries recovered after three weeks of complete immobilization in a pelvic plaster cast and the elimination of strain over a period of months. In case of a partial or total transversal severance resetting must be tried.

Two detailed clinical histories explain the method used. (Renz). Hilda H. Wullen.

## SYMPATHETIC NERVES

**Wertheimer, P.: Bilateral Supradiaphragmatic Section of the Splanchnic Nerves in the Surgical Treatment of High Blood Pressure** (La splanchnicectomie bilatérale sus-diaphragmatique dans le traitement chirurgical de l'hypertension artérielle). *Presse méd.*, Par., 1940, 48: 689.

High blood pressure is a serious condition and causes 25 per cent of the deaths of persons over fifty years of age. Medical treatment has not proved very effective and therefore surgical treatment seems to be indicated.

The operation used by the author consists of bilateral section of the greater and lesser splanchnic nerves in the mediastinum through a double dorsal incision and resection of the lower part of the dorsal sympathetic chain, including, when possible, the last 2 dorsal ganglia. Splanchnicectomy was described as a therapeutic procedure for high blood pressure by N. Pende as early as 1924, but it was not until 1933 that the details were worked out and it was applied practically by Peet. The author does not give the technical details of the operation but refers to the work of Peet and his own pupil, J. Lecuire, who discussed the operation in a Lyon thesis, No. 77 of 1939. The operation requires minute attention to detail but is not at all dangerous. The only risk is injury to the pleura, and if such a cut occurs it must be sutured or plugged with a bit of muscle or aponeurosis.

Wertheimer describes in detail 4 of the 5 cases which he operated upon by this method. The subjective symptoms stopped in all of the cases after the operation; in 1 case the blood pressure remained at 175/125 after the operation, whereas it had been 215/140 before; in 2 cases the subjective improvement persisted, although the pressure returned to the original figures. In the other cases only the immediate results are known.

The figures shown by Peet's 375 cases are more valuable. Among his patients 76 per cent showed no symptoms after operation; there was improvement in 16 per cent and failure in 8 per cent. There was a reduction of 40 mm. of mercury in the systolic pressure and of 25 mm. in the diastolic pressure in almost half of the cases (48 per cent). Forty-two per cent of the patients had been unable to work before the operation; 69 per cent were restored to normal activity. The operative mortality was only 3.8 per cent, and this was due to operation for wrong indications in the beginning.

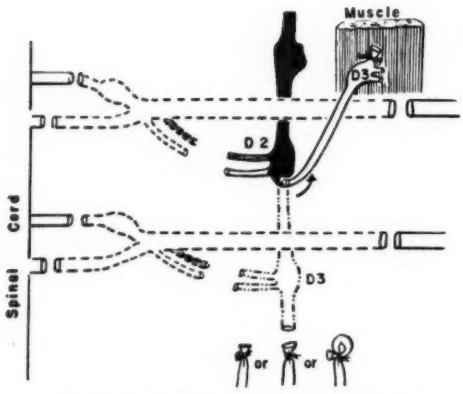
The author believes that uncomplicated hypertension is essentially due to a hypertonia of the sympathetic system; this causes a spasmodic condition of the circulation, which results in ischemia of the kidney and this in turn causes high pressure. Bilateral section of the splanchnic nerves overcomes the vasoconstrictor spasm.

The operation is indicated in uncomplicated and continuous forms of high blood pressure in which the spasmodic element predominates and arteriosclerosis has not yet developed. These spasmodic forms can sometimes be detected by ophthalmological examination. The operation should not be a last resort, but should be considered in any patient under fifty years of age who has a high diastolic pressure and a systolic pressure nearing 200, slight signs of hypertensive retinitis, a slightly enlarged heart shadow, and decreased concentrating activity of the kidneys. It is contraindicated in old age, kidney disease, and heart failure. Audrey G. Morgan, M.D.

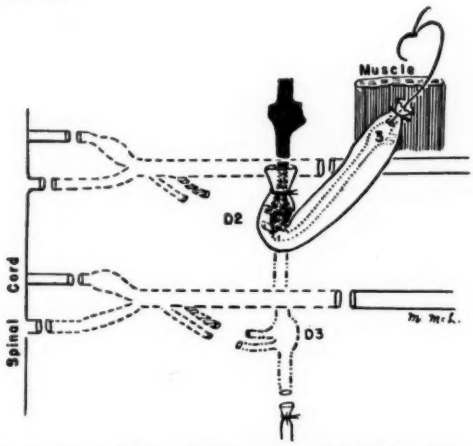
**Smithwick, R. H.: The Problem of Producing Complete and Lasting Sympathetic Denervation of the Upper Extremity by Preganglionic Section.** *Ann. Surg.*, 1941, 112: 1085.

The immediate results of intraspinal root section, the most recent modification of preganglionic section, are satisfactory and complete. Excellent late results (after two or three years) have been ob-

Intraspinal Root Section




a. With distal ligation of sympathetic trunk.




b. Covering of decentralized ganglion $D_2$ and $D_3$ with silk cylinder.

Fig. 1. The present technique combines intraspinal section of the anterior root with ligation of the distal end of the divided sympathetic trunk. More recently, the decentralized second and third ganglia and intervening trunk have been covered with a fine silk cylinder to further guard against regeneration. (Courtesy of J. B. Lippincott Co.)

tained, but in a number of cases moderate to marked evidence of regeneration has occurred. This, however, is usually delayed when compared to regeneration following ramisectomy, and is noticed during the second year in most cases.

The author's method of performing intraspinal root section is by sectioning the posterior roots of the second and third intercostal nerves proximal to the posterior root and by teasing out the intraspinal parts of the anterior roots of these nerves, after separating the attachment of the arachnoid. A spinal-fluid leak of no consequence results; the nerves are, as usual, resected inward from the lateral portion of the operative field; and the sympathetic chain is sectioned below the third ganglion. The distal end of the divided sympathetic trunk is ligated, and the decentralized second and third ganglia and intervening trunk are covered with a fine silk cylinder (Fig. 1).

With intraspinal root section the upper extremity can be thoroughly sympathectomized by interrupting the outflow from the second and third dorsal segments and dividing the sympathetic trunk below its third ganglion (the outflow from $D_1$ is not important in man). The immediate results are uniformly satisfactory; the late results are variable. Even in the presence of a considerable degree of regeneration, the blood flow to the extremity is improved, and the result worth-while from the patient's point of view. Regeneration is rarely complete. It seems reasonable to expect that further precautions which have or can be taken against regeneration will make the late results even more satisfactory.

David J. Impastato, M.D.

# DIAPHRAGMATIC HERNIA

## Collective Review

JOSEPH WEINBERG, M.D., Omaha, Nebraska

DIAPHRAGMATIC hernia has reached a position of prominence in the field of surgery in recent years largely because of the improvement in roentgenological diagnostic methods. This condition, which was formerly considered a rarity, has been discovered with sufficient frequency during the past few years to make it a matter of consideration in all obscure cases of abdominal and thoracic disturbances. The disease is often difficult to diagnose, not only because it simulates so many other diseases of the respiratory and digestive systems, but also because each case is varied in its symptomatology, changing with the variations in the content of the hernia. For these reasons it often escapes discovery for years after the patient first consults the physician, and frequently it is not recognized until he has been operated on for other conditions, such as gall-bladder disease, peptic ulcer, or appendicitis.

This review is a critical examination of the progress made in the study of diaphragmatic hernia during the past few years. Because of the contributions which have been made on the recognition and treatment of congenital hernias occurring in infancy, and esophageal-hiatus hernia, these two types are stressed in the discussion. The reader who is interested in obtaining a comprehensive review of the earlier development of the subject is referred to the study of Hedbloom (28) which appeared in 1926, in which are contained the history of the development of the subject, the anatomy, and the clinical aspects.

### TYPES OF DIAPHRAGMATIC HERNIA

The various types of diaphragmatic hernia differ greatly in their manifestations, ease of recognition, and treatment. Not only is it necessary to consider the various anatomical groups, such as esophageal-hiatus hernia, retrosternal hernia, and pleuroperitoneal hiatus hernia, but a further distinction must be made on the basis of age groups. Diaphragmatic hernia manifesting itself in infancy is a much more serious condition than that which manifests itself in childhood or later life. Experience has shown that the development of serious or even fatal symptoms occurs usually in infants and young children, while individuals who do not show symptoms until later childhood or adult life may live a normal span without developing fatal complications.

A convenient working classification of diaphragmatic hernia is that of Harrington (24):

I. Non-traumatic
  A. Congenital
    1. Pleuroperitoneal hiatus
    2. Dome of diaphragm
    3. Esophageal hiatus
    4. Foramen of Morgagni (retrosternal hiatus)
    5. Absence of left dome of diaphragm
  B. Acquired
    1. Through point of embryonic fusion
    2. Through congenital defects (Morgagni)
    3. Esophageal hiatus (enclosing sac)

II. Traumatic
  A. Indirect injury (usually severe crushing)
  B. Direct injury
    1. From gunshot or knife
    2. Rib-fracture tear
    3. Rupture of subdiaphragmatic abscess.

### GENERAL CONSIDERATIONS IN THE MANAGEMENT OF DIAPHRAGMATIC HERNIA

There are certain symptoms which may be present in any of the several types of diaphragmatic hernia and an appreciation of their significance may suggest the diagnosis to the observer. Chief among the abdominal symptoms are pain, vomiting, constipation, and distention. General thoracic symptoms are pain, dyspnea, and difficulty in swallowing. Any or all of these may be present in any of the various types. The symptoms are usually not constant in any given case but undergo frequent changes and depend upon the quantity and kind of abdominal viscera present within the thorax. The physical findings are also inconstant in most cases for the same reason. When abdominal viscera are present within the thoracic cage the most constant signs are tympany, dullness, displacement of the heart, and gurgling sounds in the thorax. There may also be symptoms and signs resulting from constriction or strangulation of special organs such as the stomach and intestines. Diagnosis is not always

From the University of Nebraska College of Medicine.

easily made from the symptoms and physical findings and it is not unusual to have the diagnosis first made at the autopsy table. Occasionally the hernia is first discovered during operation for the relief of intestinal obstruction. Any abdominal or thoracic disturbance which calls for x-ray examination may lead to the absolute diagnosis of diaphragmatic hernia. However, unless the x-ray examination is made by methods directed specifically at the detection of diaphragmatic hernia, the diagnosis may be missed. Unger and Poppel (56) emphasize the importance of using a special technique which includes fluoroscopic and roentgenological examination of the esophagus and gastro-intestinal tract in the supine, Trendelenburg, lateral, recumbent, and upright positions. Other findings which may be revealed are: gas and fluid levels in the thorax, changes in the lungs, and abnormalities in the position, shape, contour, and movement of the diaphragm.

### DIAPHRAGMATIC HERNIA IN INFANCY AND EARLY CHILDHOOD

The peculiarities of diaphragmatic hernia in infancy and early childhood place it apart from other types in the matter of management. The fact that almost all infants showing symptoms in the first few months of life die within the year (Keith 34, Hedbloom 29, and Latta 37) is proof of its seriousness. The defect is usually in the posterolateral region of the left hemidiaphragm and is the result of failure of closure of the pleuroperitoneal hiatus, usually on the left side, or through pressure against an inadequate closure. Less common disturbances are esophageal-hiatus hernia, hernia through the retrosternal foramen (foramen of Morgagni), defects in either left or right hemidiaphragm not related to the above, and defects in either hemidiaphragm other than these apertures (Hartzell 26). Kerr and Steinberg (35) describe 3 cases of diaphragmatic hernia on the right side in infants and state that the incidence of congenital hernia on the right side is about 9 per cent in congenital cases.

The symptoms and signs are due to the presence of abdominal structures within the pleural cavity. Difficulty in breathing immediately after birth should always suggest the possibility of a defect in the diaphragm. This symptom is usually inconstant; there may be a moderation of it after a few days, only to have it reappear in a few weeks or months. Other symptoms and findings which may suggest the diagnosis are failure to take feedings normally, dyspnea, a full chest and small abdomen (giving the infant the appearance of a young Hercules), displacement of the heart, the absence of breath sounds over the affected side, and failure to gain weight normally (Weinberg 57). These findings should suggest x-ray examination with a barium meal, which is the absolute means of establishing the diagnosis. The bulging thorax, if present, is especially suggestive. Daly (17) describes a child who lived eight hours, as having the anterior thoracic wall "rounded up into a lump." Cyanosis is mentioned as an important sign by Merger and De Lignieres (43), and Meyer and Hoffman (44). One would expect this sign to be present only with extreme respiratory embarrassment and its absence would not preclude an advanced degree of herniation.

Until a few years ago it was the attitude of leaders in surgery that the hazards of repair of diaphragmatic hernia in infants were so great that operation should be performed only as a palliative measure to relieve the complication of intestinal obstruction. Since then there has been a sufficiently large number of successes in infants less than a year old to prove that age is no barrier. Too often operation is withheld until the infant is *in extremis*, either from intestinal obstruction or from respiratory and circulatory embarrassment, and attempts at repair are made under most unfavorable conditions. Donovan (18), calling attention to the dangers of delayed operation, recommends surgical treatment if part of the intestinal tract is involved, because of the danger of intestinal obstruction. This statement is supported by Hartzell's analysis of 68 cases of patients under ten years of age which were operated on. Of these, 56 without intestinal obstruction showed an operative mortality of 25 per cent, while 8 with intestinal obstruction showed an operative mortality of 66⅔ per cent.

The importance of anesthesia in determining the success or failure of the operation is stressed by most surgeons writing on this subject. It should be appreciated that for practical purposes the operator is dealing with an open thorax, even though an abdominal approach is used. It should take little argument to convince him that with already embarrassed respiration the sudden inrush of air with the opening of the abdomen or thorax is very liable to cause pulmonary collapse, and that he must be prepared to use positive-pressure anesthesia whenever this danger threatens. While it is true that some patients will withstand this sudden change of pressure, the mere fact that a number of the cases can be dealt with without positive pressure is no argument against having it in readiness at all times. The technique of anesthesia which we prefer is preliminary local anesthesia, followed by the maintenance of a mild

degree of ether-oxygen or cyclopropane-oxygen anesthesia, with mildly positive pressure applied by use of the tightly fitting face mask. In using positive-pressure anesthesia, the operator should be careful to limit the pressure to that which will sustain life. Actual inflation may cause such accidents as mediastinal emphysema or spontaneous pneumothorax. It has been argued by Miller (45) and his coworkers that positive-pressure anesthesia is not necessary in those cases in which the lung is already collapsed. Apparently they argue that if the lung is already collapsed it cannot be collapsed further. Actually, positive pressure is more necessary if the lung is collapsed, because without it the shift of the intrathoracic structures, which will result from the inrush of air, will further decrease the already reduced area of functioning pulmonary tissue, and in addition will cause embarrassment to the heart and great vessels.

According to Adams (1) lung reëxpansion following intrathoracic surgery should be brought about chiefly by aspiration of air from the pleural cavity after closure of the wound. One will thus avoid the dangers of emphysema and pneumothorax which might result from excessive pressure within the bronchial tree.

The several types of surgical technique which have been described for repair of congenital diaphragmatic hernia in infants and children differ principally in the method of approach. It is generally agreed that the abdominal or thoracic approach used alone is better than a combination of the two, but in some instances it has been found necessary to use the combination because of the failure of either the abdominal or the thoracic approach alone to allow reduction of the herniated viscera. The chief argument advanced for the thoracic approach is that adhesions are more easily separated through this exposure. Even if this is true, adhesions are encountered so rarely in congenital cases operated on in early life that it would seem preferable to use the abdominal approach because of its other advantages. In the absence of adhesions it is much more difficult to return the herniated structures to the abdomen from the thoracic side than from the abdominal side. Another important argument for the abdominal approach is the fact that the herniated structures can be inspected after they are returned to the abdomen. Considerable difficulty may be encountered in returning the herniated contents, especially the intestines, from the abdominal side. The resistance to their return may be great enough to give the impression that adhesions are present. Some years ago C. H. Mayo (40) recommended the introduction of a rubber tube through the aperture in the diaphragm for the purpose of overcoming the reduced pressure within the thorax, thus allowing the intestines to escape from the thorax without resistance. The tube, about 5/8 in. in diameter, removes the vacuum within the thorax by allowing the entrance of air. This maneuver is an effective means of dislodging the structures without trauma and its use may prevent complications arising from rough handling of the intestines.

One of the most troublesome technical difficulties in the surgical repair of these cases is the closure of large apertures. Usually the simple device of placing clamps around the margin of the defect and using them for traction to approximate the edges of the ring is sufficient to obtain a closure. It is rarely necessary to paralyze the diaphragm by interruption of the phrenic nerve since the diaphragm in young children has little resistance. Hernias on the right side should be repaired through the thoracic approach since the liver would interfere with exposure of the defect on this side. The method described by Sloan (50), in which long vulsella-like forceps are used to raise the hernial ring and thus allow easier reduction of the contents, will facilitate repair in difficult cases in which the thoracic approach is used. Bettman (7) has described a method which he has successfully used with the thoracic approach in which the ribs adjacent to the defect are fractured and then pressed inward to approximate the thoracic wall and the edges of the hernial ring. Bird (8) has simplified the closure of defects next to the ribs by section and inward displacement of portions of the ninth, tenth, and eleventh ribs opposite the defect. Very large defects may be closed through the abdominal route by displacing the broad expanse of renal fascia upward and attaching it to the medial edge of the ring (5, 57, 58). This layer of fascia, which is the continuation of the anterior sheath of the psoas muscle, is sufficiently firm and sufficiently mobile to make it an ideal tissue for the closure of lateral defects. There are a few precautions to be observed with its use, the most important being to use care to avoid injury to the artery to the adrenal gland, which lies in close proximity to the posterior aspect of the fascia. There is also the danger of accidentally ligating the lienal artery because of its displacement with herniation of the spleen. It will be found helpful to leave most of the small intestine, wrapped in gauze soaked with normal saline solution, outside of the abdomen while the closure is being made. One will be able to obtain better exposure by this means, and will avoid unnecessary trauma to the

abdominal viscera. This is an important consideration, since the less trauma there is to the intestine during the operation the less likelihood there is of later distention and obstruction.

### ESOPHAGEAL-HIATUS HERNIA

Esophageal-hiatus hernia is much like indirect inguinal hernia in that both are due to a congenital weakness, but usually do not make their appearance until youth or adult age. However, also like inguinal hernia, it may be fully developed at any age. Akerlund (2) classifies hiatus hernias as follows:

1. Hiatus hernia with congenital shortened esophagus.
2. Para-esophageal hiatus hernia.
3. Other types of hiatus hernia, for example, circumscribed eventration or diverticulum of the esophagus around the hiatus.

Para-esophageal hiatus hernia, which is the most common type, is classified by Harrington (25) into:

1. Cases with an esophagus of normal length in which the lower end is not elevated above the diaphragm but a portion of the stomach is herniated into the posterior mediastinum.
2. Cases with an esophagus of normal length in which the lower end is elevated above the level of the diaphragm and the herniated stomach is in the posterior mediastinum.

It is generally thought that esophageal-hiatus hernia is due to deficient fixation of the esophagus to the hiatus or to relaxation of the crura of the diaphragm as a part of a general muscular relaxation (Cowan 16). Harrington believes that the congenitally defective hiatus is unable to withstand the pulsion and traction effects of intra-abdominal and intrathoracic pressures. Only 10 per cent of his series of 123 cases gave a history of injury and in ½ of these there were some symptoms before injury. Truesdale (53) is of the opinion that those cases which appear later in life are due to weak and greatly stretching crura; otherwise they should appear early in life. This appears to be the consensus of opinion. The recent widespread interest in the subject of esophageal-hiatus hernia has brought to light many cases. The symptoms are chiefly those due to the presence of the stomach above the diaphragm, and they frequently simulate those of other diseases of the abdomen and thorax, including such gastroenterological conditions as gastritis, gastric ulcer or cancer, pylorospasm, duodenal ulcer, or cholecystitis; esophageal conditions such as cardiospasm, diverticulum, stricture, or carcinoma; and cardiac conditions such as angina pectoris, coronary occlusion, and myocardial insufficiency (Morton 48, Harrington 25, Cowan 16). Mistakes in diagnosis, even to the point of operating on individuals for erroneously diagnosed conditions such as gall-bladder disease, gastric ulcer, and duodenal ulcer, must occur with much greater frequency than is generally supposed if one may judge from the high percentage of cases of diaphragmatic hernia which have previously been operated on for other conditions (2, 16, 25, 48, 53). While esophageal-hiatus hernia may be confused with many diseases of the thorax and abdomen, there is more uniformity in the manifestations of this type of hernia than with most other diaphragmatic types. According to Harrington these symptoms are based upon intermittent or progressive incarceration and obstruction of the stomach. This may cause epigastric distress extending to the back, usually shortly after a heavy or even ordinary meal, which is relieved by vomiting or eructation. Later there may be agonizing pain and difficulty in vomiting because of fixation of the stomach. Other symptoms suggestive of the condition are phrenic shoulder pain, dyspnea, and a sense of intrathoracic pressure which is made worse by lying down. A carefully elicited history of these symptoms becoming progressively worse may lead to the diagnosis even in obscure cases, especially when gall-bladder disease is suspected but is indefinite. On the other hand, if the diagnosis is not suspected it may be missed even at the operating table, and it is probably true that many cases operated on for gall-bladder disease in which the gall bladder was found to be normal have been cases of esophageal-hiatus hernia.

Attention has been centered in recent years particularly upon anemia due to a slow blood loss resulting from mechanical conditions imposed upon the stomach by the esophageal ring. Bock, Dulin, and Brooke (10) have given a very complete account of this association in their presentation of 10 cases. The most important lead to the diagnosis in their cases was repeated attacks of anemia. Among others who have emphasized the occurrence of attacks of anemia as an important association of hiatal hernia are Andrews (4), Mathews (39), Cowan (16), Moersch (46), Harrington (25), Feldman (20), and Gordner (21). Bergenfeldte (6) reports a case of hematemesis in an eighteen-month-old boy in which there was cessation of bleeding after repair of the defect, and Christiansen (12) reports the case of a child one year old in which the esophageal-hiatus hernia was associated with hematemesis. In most reports the association of anemia and hernia occurred in the older age groups. The apparent

cause of bleeding in some cases was ulceration of the stomach or esophagus at the site of the hernial ring. The autopsied cases in the series reported by Bock and his coworkers showed no evidence of ulceration, and the authors considered venous congestion as the most likely cause of the bleeding. Before accepting this conclusion one would have to rule out the presence of small superficial ulcers which were not discovered at autopsy. There is also the possibility that the anemia is not related to the hernia in some cases. The comparatively large number of cases which have been reported in recent years would indicate, however, that the association of anemia and hernia is no mere coincidence and that hernia should be considered in all obscure cases of secondary anemia.

The occasional occurrence of stricture in the lower third of the esophagus with hiatal hernia may give rise to confusion. This complication in the older age groups makes one suspect the possibility of carcinoma, and the occasional presence of carcinoma of the esophagus together with hernia (Jacobs 33) makes the possibility of this confusion the greater. Progressive constriction in the lower third of the esophagus with a history of a disturbance suggesting gall-bladder or gastrointestinal disease over a period of years should suggest the possibility of this disturbance.

Improved methods of roentgenology together with an awareness of the possibility of hiatal hernia are responsible for the great increase in the diagnosis of this condition. What applies to diaphragmatic hernia in general in the method of making the roentgenological examination applies to the esophageal-hiatus type, since, in the early cases without adhesions, the stomach and other abdominal viscera may not be herniated at the time of x-ray examination, and ordinary methods of examination may give no clue to the diagnosis. The roentgenological findings which Ude and Rigler (55) emphasize as being of importance are:

1. Protrusion of a portion of the stomach through the esophageal hiatus.
2. Distention of the lower part of the esophagus.
3. Demonstration of the dilatation of the hiatus by the stomach rugæ markings in the herniated portion.
4. Changes in the contour of the stomach.

If roentgenological examination is performed routinely on large groups of cases, many instances of small pouchings of the stomach through the relaxed hiatal ring will be discovered but most of these have no clinical significance. One must, therefore, be wary of assuming that an abdominal or thoracic disturbance is due to hiatal hernia on such evidence alone.

Moersch (46), Jackson and Jackson (31), and Monkhouse and Montgomery (47) stress the value of endoscopic examination of the esophagus and herniated stomach in cases in which there is doubt regarding the type of lesion which exists. A superficial erosive ulcer may be visualized at the site of the hernial ring and at the junction of the stomach and esophagus in occasional instances. It is possible that progressive constriction resulting from these ulcers accounts for the esophageal obstruction found in some cases.

Thoracic stomach with short esophagus has been described with increasing frequency during the past several years. These cases must be considered apart from other types of hiatal hernia, especially from the standpoint of treatment, since the short esophagus precludes or makes difficult the placement of the stomach in its normal position below the diaphragm. The diagnosis is often made without sufficient evidence, and it is a safe rule to classify only those cases in which the position is demonstrated by operation or autopsy as being definitely within this group (Jacobs, Tweedie, and Negus 32). Manges and Clerf (38) advise that the stomach and esophagus be filled completely with the barium meal to make the diagnosis, and that roentgenograms be taken from many angles. The findings with esophagoscopy include: short esophagus, narrowing of the esophagogastric junction, finding of a portion of the stomach above the diaphragm, absence of a normal esophageal hiatus, and ulcers in some cases, usually at the junction of the esophagus and stomach. Further evidence may be obtained by biopsy study (Block, Serby, and Salinger 9). The reason for the occurrence of a short esophagus with the thoracic stomach is not clear. Theories of the cause include deficient fixation of the esophagus to the hiatus, congenital failure of development of the esophagus, herniation of the stomach through the esophageal hiatus with later shortening of the esophagus due to ulceration, and cessation of traction on the esophagus by the stomach which has assumed a position in the thorax (52, 16, 25). In view of the fact that most of the cases diagnosed as short esophagus which have come to operation have proved to be hiatal hernias without shortening, one should be reluctant to make an absolute diagnosis of this rare condition.

A very definite advance in the management of the esophageal-hiatus hernias is the recognition by surgeons and internists alike that many cases may be treated by medical therapy without surgical intervention. The various methods which find application in the treatment of this condition may be classified under four headings:

1. Medical management.
2. Treatment of esophageal strictures with dilating sounds.
3. Relief by interruption of the phrenic nerve.
4. Radical surgical repair.

All of these may be used either alone or in combination.

Held and Goldbloom (30) advocate a medical program which consists of: (a) small frequent feeding of a bland diet; (b) sleeping with the head of the bed elevated; (c) the use of anti-spasmodics and sedatives before retiring; (d) supportive and anti-anemic medication of vitamins, iron, and transfusions as they are indicated; and (e) occasional aspiration of the stomach before retiring to free the sac of food. They consider this program applicable except in acute constricting lesions. Among others who have stressed the importance of careful medical management are Guthrie and Jones (23), Chamberlain (11), and Wilkinson (59).

The indications for endoscopic treatment of esophageal strictures, which may be the chief cause of symptoms resulting from hiatal hernia and thoracic stomach with short esophagus, are well described by Clerf and Manges (13). In a series of 14 cases diagnosed as congenitally short esophagus, these authors were able to give considerable relief by dilatation of the constriction. They considered the application of 10 per cent silver-nitrate solution to visualized ulcers to be helpful.

Interruption of the phrenic nerve, either as a palliative measure when surgical repair is inadvisable or as a preliminary procedure in contemplated repair, frequently results in lasting relief without further surgical treatment. Cohen (15) reports relief from this procedure in 2 adult patients who were considered to be in too poor condition for surgical repair. Harrington (25) found that phrenic-nerve interruption alone gave marked relief in a majority of patients upon whom this procedure was performed. It was used as a palliative procedure in those cases in which he considered radical operation contraindicated. It would seem best to use temporary interruption at first if there is a possibility that the hernia will be repaired later. This can be converted into a permanent interruption at some future time if it is desired.

The surgical repair of hiatal hernia is most easily accomplished through the abdominal approach in most cases since this allows a more direct exposure of the tissues to be sutured. The approach to the hiatus is greatly facilitated by a procedure described by Lambert (36) in which a midline upper abdominal incision and a transverse incision from the umbilicus to the axillary line are amplified by division of the seventh, eighth, and ninth ribs near their cartilages. The left lateral ligament of the liver is then divided and the left lobe of the liver displaced to the right to give further exposure. This procedure or one of its modifications (Grey-Turner 22, Clute and Albright 14) will allow the operation to be performed with comparative ease in cases in which repair would otherwise be difficult or impossible. Truesdale (53) is of the opinion that most hiatal hernias should be approached by the abdominal route, but those associated with adhesions should be approached through the thorax. He assumes that adhesions are present if the stomach remains herniated when the patient is in the upright position. Harrington, however, uses the abdominal route in all cases and has been successful with this method in a very large series. Dunhill (19) plans the treatment according to the type of hernia and his excellent results in serious cases in which he has used the thoracic, abdominal, and thoracoabdominal approaches testify to the soundness of this attitude. All of the precautions used in the surgery of diaphragmatic hernias in general, including positive-pressure anesthesia, aspiration of air from the pleural cavity immediately following operation, and oxygen therapy when it is indicated, apply also to the repair of esophageal-hiatus hernia. A precautionary measure which deserves special mention is the insertion of a large stomach tube into the thorax and stomach while the defect is being closed, to decrease the possibility of injury to the esophagus.

### DIAPHRAGMATIC HERNIA ON THE RIGHT SIDE

Diaphragmatic hernia on the right side is considered as an entity because of its rarity and because of the peculiar problems which arise in its treatment. The hernia is usually through the pleuroperitoneal canal, through the parasternal foramen, or through an aperture caused by trauma. It presents much the same symptoms as diaphragmatic hernia on the left side, the chief differences being that the heart is displaced to the left instead of to the right, the right lung is compressed, and there is usually less of the small intestine contained within the thorax. The thoracic approach is generally considered best since the liver acts as a barrier when the abdominal approach is used.

Hernia on the right side in which the orifice is near the midline, as herniation through the parasternal foramen, may be attacked successfully through the abdomen (Thomas 51, Meade and Ravdin 42). In some instances a combined ap-

proach may be found useful, just as with other types of diaphragmatic hernia (Andre 3).

### TRAUMATIC DIAPHRAGMATIC HERNIA

Traumatic diaphragmatic hernia may be due to either direct or indirect violence, the former being the result of stab wounds, tears by fractured ribs, or perforations due to missiles which penetrate the lower part of the thoracic or abdominal wall. One would think that war injuries would cause far more hernias of the diaphragm than are generally seen by the army surgeon, but, as Truesdale and Phippen (54) have pointed out, missiles which penetrate the diaphragm usually cause immediately fatal injuries. The indirect hernias are due to forceful compression injuries of the abdomen which cause sudden tension on the diaphragm. Even sneezing has been designated as a cause (McMullin, McArthur, and Weber 41).

The repair of traumatic hernias by the thoracic approach has several arguments in its favor (Hedbloom 27, Schiffbauer 49, and Truesdale and Phippen 54). The thoracic viscera are more easily inspected for possible injury, and adhesions are more easily divided. As adhesions are almost always present in late traumatic diaphragmatic hernia, any method which facilitates their separation is an important consideration. An argument against the thoracic approach is the difficulty of dealing with abdominal viscera which may be injured. One may be governed to a considerable degree by the level of entrance and the direction of the rupturing force in choosing the approach for the repair.

### SUMMARY

1. The utilization of the x-rays has made it possible to recognize diaphragmatic hernia with greater frequency than was possible before the development of a better roentgenological technique. This has helped uncover a greater number of cases of diaphragmatic hernia and has been particularly valuable for the recognition of obscure cases in which the symptoms are poorly defined.

2. Harrington's classification of diaphragmatic hernia is adaptable to clinical grouping of the various types.

3. The peculiarities of diaphragmatic hernia in infancy and early childhood are distinctly different from those encountered in the adult and the treatment must necessarily differ accordingly.

4. The procedures employed in the different types of hernia are discussed, and particular reference is made to the relative merits of abdominal and thoracic approaches.

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# SURGERY OF THE THORAX

## CHEST WALL AND BREAST

**Schrire, T.: Stab Wounds of the Chest.** *Brit. M. J.*, 1940, 2: 662.

In Capetown, stab wounds have become extremely common. One hospital, serving the town and neighboring suburbs, has treated 600 cases annually. From such a multitude of cases, it was not difficult to get a number large enough to draw some broad conclusions.

Unless the condition of the patient was so bad as to render any operative intervention an entirely hopeless procedure, every patient with penetrating wounds of the chest admitted under the care of the author was subjected to an exploratory thoracotomy as an emergency measure, if he was seen within twelve hours of the injury. As a rule, the diagnosis was obvious; the presence of surgical emphysema, pneumothorax on the same side, and shift of the apex beat were at all times considered evidence of penetration. Associated injury and multiple stab wounds were frequent.

The author describes the pre-operative treatment, the anesthetic, the incision, and the operation. Resection of the rib is performed if necessary. A rib separator is also introduced. All hemorrhage must be controlled, and the blood in the pleura evacuated by mopping, in preference to suction. The lungs are grasped with a lung forceps and lifted up into the wound, and the surfaces of each lobe are examined. The penetrating wounds are sutured. The pleural surfaces usually come into apposition easily; if not, one or two extra stitches bring them together. The diaphragm is stitched with two layers of catgut. Before stitching the diaphragm, it is advisable to crush the phrenic nerve as it lies on the pericardium. Wounds of the heart are treated by suturing with chromic catgut No. 2. The pericardium is left widely open and is allowed to drain into the left or right pleura. No separate drain is used for the pericardium. Before the chest is closed, a No. 14 self-retaining catheter is put into a separate stab wound low down in the posterior axillary line.

Following the operation, the patient is returned to bed and the drainage tube is led under water. He is sat up as soon as he recovers for the anesthesia, is nourished in the Fowler position, and given inhalations of carbon dioxide for two to three minutes every half hour for the first twenty-four hours. In addition, he has been given full doses of sulfonamide for the first few days. The tube is removed after thirty-six hours, during the first twenty-four of which about 8 to 10 oz. of blood-stained fluid are discharged; during the last twelve hours, there is practically no discharge. The purpose is to get the lungs reëxpanded as soon as possible. He has not seen a tension pneumothorax develop after suturing in his series, but he uses a wide self-retaining tube, to be on the safe side. The patients move about freely in their beds after the drainage tube is removed and do not complain of any pain. The author believes it essential to keep the lungs fully aerated and not to allow the bronchi to become blocked with secretion or blood. Coughing is encouraged.

In all, 17 patients were treated by the above method, with 1 death. For comparison, 9 patients were treated conservatively. It is the author's belief or impression that operation in these cases is worthwhile. EMIL C. ROBITSHEK, M.D.

**Rovida, F.: Extrapleural Abscesses** (Degli ascessi extrapleurici). *Radiol. med.*, 1940, 27: 768.

Extrapleural abscesses are formed between the pleura and the wall of the thorax. The clinical symptoms are generally slight. The patient may have a vague pain at the site of the abscess and a cough. If the abscess is tuberculous in nature the absence of pain is characteristic. There may be an external swelling covered with skin that is edematous but not red or fixed. This swelling appears in

Fig. 1

the intercostal spaces but is not pathognomonic of extrapleural abscess. These abscesses may be divided into two groups depending on their point of origin; they may develop in the soft parts of the wall of the thorax or they may originate from a focus, either tuberculous or septic, in the ribs. Probably the great majority of them originate from pyemic or tuberculous foci in the ribs.

Diagrammatic sketches are given illustrating the method of propagation of these abscesses and 4 cases are described in detail and illustrated with roentgenograms. The roentgenogram reproduced herewith (Fig. 1) shows a typical case of solitary extrapleural abscess on the left side in tuberculosis. Some of the roentgenograms in the original article show a series of such abscesses along the wall of the thorax. These abscesses show a shadow, the margin of which extends into the transparency of the lung. In the tangential projection the outline extending toward the lung is quite characteristic, which makes it possible to differentiate the abscess from other conditions, such as, for example, sacculated parietal empyema. The shadow of an extrapleural abscess is longer in its horizontal than in its vertical diameter and the maximum convexity lies opposite the center of the base on which it is implanted. When examination is made in the tangential projection during respiration the outline flattens on inspiration and returns to its original position on expiration. Differential diagnosis from other conditions, such as tumors and gummas, is discussed.

If the ribs are involved, treatment should be surgical, whether the infection is pyogenic or tuberculous. If the abscess is tuberculous and in the beginning stage and the ribs are not involved, physical and medical treatment may be tried. Roentgen examination is of value in determining the treatment to be used and following up the course of the lesion under treatment.

AUDREY G. MORGAN, M.D.

**Moratti, A.: Pre-Operative Radiotherapy of Cancer of the Breast** (Sulla radioterapia preoperatoria del cancro della mammella). *Radiol. med.*, 1940, 27: 783.

The author discusses 25 cases of cancer of the breast given pre-operative radiotherapy between 1921 and 1938. A table is given which shows the details of the treatment and the results. When the report was written the average time since the beginning of treatment was three years, the shortest time five months, and the longest more than seventeen years. Two of the patients, or 8 per cent, were in the first stage; 9, or 36 per cent, were in the second stage; and 14, or 56 per cent, were in the third stage (according to Portmann's classification).

The treatment was roentgen irradiation except in one case in which 3 mgm. of radium were applied for ninety-six hours; in another case in addition to the administration of 2,000 roentgens, 25 mgm. of radium were applied for twenty-five minutes the day before operation. The tension used was from 200 to 300 kv. In the first and second stages the breast and axillary region were irradiated, in the third stage the supraclavicular region was also irradiated, and in cases of very large tumor in the third stage a posterior irradiation was given also. The factors of irradiation were: average doses, from 2,400 to 2,800 roentgens per field; the anticathode-skin distance, from 50 to 60 cm., filter, 2 mm. of copper and 2 mm. of aluminum; and daily irradiations.

Of the 25 patients, 20 were operated on in the second or third month after the beginning of irradiation. At least three weeks should elapse between the end of roentgen treatment and the operation.

It has been claimed that the delay in operation entailed in radiotherapy is dangerous and that preoperative irradiation makes operation more difficult. In this series there was no difficulty in operation except that perhaps in some cases hemostasis was somewhat more difficult. It has also been claimed that roentgen irradiation injures the lung tissue and tends to cause pleuropneumonia. The author found that there was no danger of lung complications if lung disease was excluded before operation and careful roentgen technique was used.

Histological examination showed regressive changes in the tumor tissue after irradiation. Hard, scirrhous cancers were affected less than others. As a general thing, these changes became manifest three weeks after irradiation, as shown by serial biopsies in 1 case.

Fourteen patients were found free of signs of recurrence after an average interval of more than four years since treatment. Both of the patients who had had the first stage were living and free of recurrence; among the 9 with the second stage there had been 1 recurrence, (22.22 per cent); and among the 14 with the third stage there had been 10 recurrences, or (71.43 per cent). These results are better than those of other authors for operation alone. The time that elapsed between operation and recurrence was also longer than in the statistics reported for operation alone.

The number of cases reported is small, but they show that the dangers attributed to pre-operative irradiation are not real. Irradiation was followed by satisfactory results in the first and second stages, and even in the third stage the tumors were sometimes rendered operable. Therefore, the method is worthy of more extended use.

AUDREY G. MORGAN, M.D.

## TRACHEA, LUNGS, AND PLEURA

**Scartozzi, C.: The Metabolism of Oxalic Acid in Patients with Pleuropulmonary Suppuration** (Metabolismo dell'acido ossalico nei malati di suppurazioni pleuropolmonari). *Policlin.*, Rome, 1940, 47: sez. chir. 476.

The author studied the oxalic-acid metabolism in a series of 15 cases of pleuropulmonary suppuration. He notes that oxalic acid in the body may be either of endogenous or exogenous origin. Exogenous oxalic acid is introduced in such foods as cocoa, and spin-

ach, or results from microbic fermentation in the gastro-intestinal tract. Endogenous oxalic acid is derived from the intermediary metabolism of nucleoproteids and amino-acids, fats, purine substances, but, above all, from carbohydrates. In fact, the blood-sugar curve is paralleled by the blood-oxalate curve. This demonstrates the intimate relation between the metabolism of the carbohydrates and oxalic acid.

Disturbances of the liver affect the carbohydrate metabolism, and likewise the oxalic-acid metabolism. Studies of oxalic-acid metabolism on hepatic, diabetic, and tuberculous patients indicate a hyperoxalemia. Normal values for blood oxalic acid fluctuate between 2 and 6 mgm. per 100 c.cm. The twenty-four-hour urine usually contains from 50 to 120 mgm. total excretion.

The author found in the clinical cases reported a hyperoxalemia in the presence of pleuropulmonary suppuration. He ascribes this to the endogenous metabolism. Hepatic insufficiency in such cases may also be a cause of the hyperoxalemia. We know that chronic pulmonary suppuration may depress hepatic function and even cause amyloid degeneration. The author also found an increase in the urinary excretion of oxalic acid in such cases. With improvement of the patient's condition the blood and urinary oxalates return to normal. JACOB E. KLEIN, M.D.

**Symposium on Carcinoma of the Lung. Halpert, B.: Morphological Aspects of Carcinoma of the Lung. Singer, J. J.: Primary Bronchiogenic Carcinoma. Moore, S.: Body-Section Radiography in Malignancy of the Lower Respiratory Tract. Holinger, P., and Radner, D. B.: Bronchoscopic Diagnosis of Bronchial Carcinoma. Craver, L. F.: Diagnosis of Malignant Lung Tumors by Aspiration Biopsy and by Sputum Examination. Churchill, E. D.: Resection of the Lung. Ochsner, A., and DeBakey, M.: Surgical Considerations of Primary Carcinoma of the Lung.** *Surgery*, 1940, 8: 903-1023.

HALPERT states that among 7,433 autopsies at Charity Hospital, New Orleans, there were 92 cases of carcinoma of the lung, which incidence was more than half as frequent as carcinoma of the stomach. The proportion of males to females was 14:1 and the majority of the patients were between forty and sixty years of age. In 42 cases the growth was located in the right or left stem of the bronchus; in 35 cases it was located in a branch bronchus.

Halpert's concept is that the parent cell of all carcinomas of the lung is the reserve-cell. He classifies carcinomas of the lung as squamous-cell, columnar-cell, and reserve-cell carcinomas.

In the squamous-cell type the tumor cells are arranged more or less concentrically to form epithelial pearls, and the cells toward the centers of the cell nest disclose varying degrees of keratinization or are transformed into keratinized scales or débris. In the columnar-cell type the tumor cells are columnar or cuboidal and are arranged in acinar, tubular, or papillary structures. In the reserve-cell type the tumor cells are of the same size; their nuclei are round, oval, or elongated and stain deeply; their cytoplasm is scanty; and their borders are scarcely discernible. The cellular arrangement forms no particular pattern. In some, growth of the cells is arranged in whorls; in others, there is a palisade arrangement of the peripheral cells.

Among the 92 cases, 49 were squamous-cell, 17 were columnar-cell, and 26 were reserve-cell carcinomas.

The tumor usually originates in the mucous membrane of a bronchus or a branch and extends into the deeper layers. The regional lymph nodes are first involved and later more distant lymph nodes. Metastasis into distant organs occurs.

SINGER states that carcinoma occurs most frequently between the ages of forty and seventy. A case has been reported in a sixteen-month-old child. The proportion between males and females is 4 to 1, and between the right and left lung 60:40.

The early symptoms are cough, chest pain, wheeze, dyspnea, and hemoptysis. The late symptoms are those of advanced malignancy. Most patients manifest the important symptoms which precede their death from one to fifteen months. There is no known definite relation to occupation.

The roentgen-ray picture is not due entirely to the tumor mass, but to the mass plus the complicating pathology such as atelectasis, bronchiectasis, pneumonia, abscess, pleural effusion, pleural thickening, or obstructive emphysema.

The most important complications are varying degrees of atelectasis, abscess, bronchiectasis, pleural effusion, emphysema, and spontaneous pneumothorax.

Physical signs are so variable that they are not reliable. Diagnosis can be established by a careful history and physical examination, sputum examination, fluoroscopy, bronchoscopy, bronchography, and roentgenography, by diagnostic puncture and aspiration biopsy, and occasionally by thoracoscopic examination or exploratory thoracotomy.

MOORE says that 65 per cent of cases of bronchiogenic carcinoma can be diagnosed by bronchoscopy and 35 per cent cannot. Any means which will aid in the discovery of the early occluding lesion should reduce the number that cannot be diagnosed. Body-section roentgenography consists in employing a properly coördinated movement of x-ray tube and film during the x-ray exposure with the result that a predetermined layer in the body can be shown with more or less exclusion of the structures lying above or below the layer under examination. The five major types of apparatus are: the stratigraph (Vallebona), planigraph (Ziedses des Plantes) tomograph (Grissnabb and Chaoul), laminagraph (Kieffer and Moore), and the biotome of Bocage.

Body-section roentgenography is of the greatest value in the examination of the respiratory tract. It has proved a great help in diagnosing obscure lesions and with increasing use and experience it

should aid greatly in diagnosing and localizing bronchiogenic tumors.

HOLINGER and RADNER report that the purpose of bronchoscopy as an aid in the diagnosis of bronchiogenic carcinoma is: (1) to study the character of the lesion; (2) to note accurately its location and determine its extent along the bronchial walls; (3) to secure tissue for biopsy and thus reveal the exact nature of the growth; and (4) to aid in determining operability by noting evidence or lack of evidence of metastasis.

Symptoms of unexplained cough, hemoptysis of unknown origin, or wheezes demand a thorough examination including bronchoscopy to determine their cause. When x-rays suggest bronchial obstruction with either atelectasis or emphysema, pneumonitis or suppuration, bronchoscopic examination is imperative. Early carcinoma of the bronchus produces but few symptoms and x-ray findings are negative in the early stage.

There are three types of tumors that may produce bronchial obstruction: (1) endobronchial; (2) peribronchial, producing a thickening of the bronchial wall; and (3) extrabronchial, obstruction being produced by compression of the bronchus.

Biopsy is positive in approximately 70 per cent of the cases. The bronchoscopic picture is, of course, variable. The aid of a retrograde bronchoscope (Tucker) is necessary to examine the upper lobe bronchi.

A thickened, widened carina indicates involvement of the mediastinal lymph glands.

Bronchoscopy has little to offer therapeutically in the treatment of carcinoma of the bronchus. Palliation may be obtained occasionally by electrocoagulation, radon, or radium implantation.

CRAVER states that either the modern surgical or the modern radiological treatment of cancer of the lung is such a radical procedure, and so hazardous to the patient that it should not be undertaken without good evidence of its necessity.

In a number of patients diagnosis cannot be proved with the bronchoscope or x-rays. Thoracotomy is a major surgical procedure and should not be resorted to as a diagnostic procedure except in unusual cases. Thoracoscopy may help to determine the presence of pleural metastasis. Examination of sedimented or centrifuged pleural fluid is notoriously unreliable in making a diagnosis of cancer of the lung.

For more than ten years aspiration biopsy has been used with increasing frequency at the Memorial Hospital. During the years from 1935 to 1939, the diagnosis of 51.6 per cent of the cases histologically proved as carcinoma was established by aspiration biopsy.

When all methods have failed to establish the diagnosis, aspiration biopsy is used.

Accurate localization of the tumor is made with the aid of the fluoroscope. Previously this was done in the erect posture, but now the patient is placed in the prone position with his head slightly lower than the body to avoid cerebral air embolism. A biplane fluoroscope would be of great help.

A detailed description of the technique is described and should be carefully studied by one undertaking to do this procedure.

The chief danger is air embolism, which should be lessened by placing the patient in the recumbent posture. Expectoration of small amounts of blood not infrequently occurs. The development of empyema or lung abscess or growth of tumor along the needle tract has not occurred at this hospital.

In CHURCHILL'S clinic general inhalation anesthesia with an ether-vapor oxygen is administered through an intratracheal tube with a closed system that permits the maintenance of differential pressure and affords ready access for aspiration of the tracheobronchial tree.

Churchill employs a posterior approach through the bed of the eighth rib for lower lobectomy, a posterolateral incision at a level between the fifth and seventh ribs for pneumonectomy, a posterolateral or anterolateral incision for the upper lobe, and an anterolateral incision for the middle lobe.

The author then describes in detail the technical procedures and their applications to various types of diseases of the lungs. The reader is referred to the original article for them.

Churchill does not think that preliminary artificial pneumothorax is of any particular value in the preoperative preparation of patients for pneumonectomy or lobectomy.

He reports his hospital mortality rate for all pulmonary resections during a ten-year period as follows:

| Condition | Number of Resections | Deaths in Hospital | Per Cent of Deaths in Hospital |
|---|---|---|---|
| Bronchiectasis | 133 | 4 | 3.0 |
| Lung abscess | 28 | 5 | 18.0 |
| Cystic disease | 6 | 2 | 33.3 |
| Tuberculosis | 5 | 1 | 20.0 |
| Benign tumors | 11 | 2 | 18.1 |
| Malignant tumors | 35 | 16 | 45.7 |
| Total | 218 | 30 | 13.8 |

| Type of Operation | Number of Operations | Deaths in Hospital | Per Cent of Deaths in Hospital |
|---|---|---|---|
| Lobectomy | | | |
| Partial | 6 | 0 | |
| Complete | 166 | 9 | |
| Total | 172 | 9 | 5.2 |
| Pneumonectomy | | | |
| Single stage | 40 | 19 | |
| Lobar stages | 6 | 2 | |
| Total | 46 | 21 | 45.6 |
| All resections | 218 | 30 | 13.8 |

OCHSNER and DEBAKEY report that there is an actual increase in the frequency of carcinoma of the lungs. A review of the literature and their own ex-

perience would indicate that irradiation therapy is of no benefit in the treatment of bronchiogenic carcinoma. Total removal of the lung and mediastinal lymph nodes is feasible and offers the only hope of cure. Early diagnosis is essential to successful operation. Operability can be absolutely determined only by exploratory thoracotomy, and they urge that it should be done on all cases that are not obviously inoperable.

The authors have discussed in detail the pre-operative management, the anesthesia, and the technique of individual ligation of the hilar structures. They believe that the pre-operative administration of cevitamic acid and thiamine chloride is helpful. The pre-operative establishment of artificial pneumothorax is important. They condemn lobectomy and pneumonectomy by the tourniquet technique as inadequate and believe that pneumonectomy by the individual ligation technique with removal of the mediastinal lymph glands is the operation of choice.

They have presented an analysis of 139 collected and 19 personal cases, 94 per cent of which were primary carcinoma and 2.9 per cent primary sarcoma. The total mortality in this group was 45 per cent. The follow-up results of 67 of 83 collected cases, including theirs, show that 70 per cent of the patients are still living. In their series of 19 cases, 10 patients recovered following operation. Of these, 7 are still living, the longest survival being four and one-half years. JULIAN A. MOORE, M.D.

**Longacre, J. J., and Johansmann, R.: An Experimental Study of the Fate of the Remaining Lung Following Total Pneumonectomy.** *J. Thoracic Surg.*, 1940, 10: 131.

The authors undertook to study the changes in the remaining lung following pneumonectomy in dogs with a view to solving the following problems:

1. What is the fate of the remaining lung after years of carrying the added strain?

2. Will this fate in those young developing animals operated upon while the growth factor is still present be identical to that in animals subjected to pneumonectomy after maturity is reached?

3. In time, will the compensatory dilatation noted in the adult animals following pneumonectomy terminate in true pathological emphysema with all of its embarrassing effects?

A group of dogs (some operated on as puppies, others as adult animals) have been followed up and studied at intervals up to four years.

The intrapleural pressure was found to become lower as time went on, which showed a loss of elastic recoil. This was true in the puppy and in the adult dog which had one lung removed.

On a moderate severe strain test, the animal operated upon as a puppy showed definite embarrassment but not the degree of exhaustion shown by the animal operated upon as an adult.

The anoxemia test shows that the cardiorespiratory reserve is cut in half by removal of 50 per cent of pulmonary tissue, but that it will come back to from 75 to 80 per cent within twelve months in animals operated on as adults. Part of this return of function is lost after the animal grows older.

In dogs operated upon as puppies, there is definite evidence of hyperplasia of the lung, little evidence of emphysema, and little evidence of loss of elastic tissue. In dogs operated upon as adults a dilatation of the alveoli develops and there is evidence of the development of chronic emphysema as seen in the breaking of the alveolar walls, thickening and clubbing of their broken ends, collapse of the capillaries, and fragmentation of the elastic tissue.

These same findings might be applied to man. The remaining lung of the young may hypertrophy, but in the adult probably a compensatory emphysema develops. JULIAN A. MOORE, M.D.

## ESOPHAGUS AND MEDIASTINUM

**Gagna, F., and Bassignana, D.: Esophagotracheal Fistula Due to Carcinoma of the Esophagus** (Fistola esofago-tracheale da carcinoma esofageo). *Minerva med.*, 1940, 31: 344.

The authors state that the statistics show that perforation of the esophagus caused by esophageal cancer is rather frequent and that esophagotracheal fistula predominates among the perforations involving both the esophagus and the respiratory tract. This is due to the anatomical relationship of the esophagus to the trachea and also to the frequency of occurrence of carcinoma at the bifurcation of the trachea, which is a site of physiological constriction. In most cases, there is a single, short fistula, but in some the fistulous tract is extensive. Usually, the orifice is small and more or less obturated by the tumor; it may be so narrow as to escape careful clinical and roentgenological investigation and may be discovered only at autopsy. In half of the cases, the presence of fistula is revealed by an acute respiratory crisis which may result in syncope followed by death; in other cases, the beginning is slow and insidious, being marked only by slight cough immediately after deglutition, a feeling of oppression, and, at times, some traces of blood in the sputum. Some patients can take small amounts of fluid without experiencing any disturbances, and others succeed in feeding themselves by assuming some particular posture or by taking a deep inspiration, closing the glottis, and then swallowing the food. Patients with esophagotracheal fistula are exposed not only to bronchopulmonary complications but also to progressive general debility from defective nutrition; gastrostomy may become necessary to feed the subject, but the prognosis is unfavorable. In 75 per cent of the cases, the patient dies from pulmonary complications within one month after the fistula has been established clinically.

The authors report a case in which the first symptoms of perforation occurred about three and one-half months after the appearance of esophageal disturbances due to cancer. In the beginning, the

symptoms were only suggestive, but later they became decisive. The suggestive signs included cough on deglutition accompanied by expectoration of ingested substances, frequent and copious eructations, and decrease in the strength of the voice due to decreased pressure in the trachea because air was escaping into the esophagus. The decisive signs were a blowing murmur, synchronous with respiration, perceived at the end of a sound introduced into the esophagus to the level of the obstruction, and the results of the roentgen examination which established the presence of the fistula. The latter examination is indispensable for the differential and etiological diagnosis of esophagotracheal perforation, but it is necessary to remember that the passage of opaque substance into the respiratory tract is insufficient to justify the acceptance of esophagotracheal fistula because various anatomical or functional disturbances of deglutition may enter into the picture. Highly located or marked stenosis of the esophagus favors the arrest or more or less rapid regurgitation of the opaque meal which may then easily pass into the larynx and the trachea and, if this occurs rapidly, may raise a doubt concerning the real route taken by the opaque substance to reach the bronchi. On the other hand, esophageal stenosis, which is usually associated with the fistula, may help to establish the diagnosis because it indicates the exact site of the obstacle and of the communicating tract. The ease with which the fistula can be demonstrated will depend on the size and direction of the fistula as well as upon the degree and low localization of the associated stenosis.

The examination must be started with the administration of small amounts of very fluid opaque substance, followed by larger amounts of a thicker but never solid meal. The tolerance of the patients for opaque substances, whether barium or bismuth salts, is usually good when the above-mentioned method is used. The importance of esophagoscopy and of bronchoscopy, when it is possible to use them, should not be overlooked because they may give positive diagnostic data in conjunction with the other symptoms. There were no grave bronchopulmonary complications during the entire course of the disease in the present case. RICHARD KEMEL, M.D.

# GASTROJEJUNOCOLIC FISTULA

## Collective Review

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THE occurrence of gastrojejunocolic fistula after gastrojejunostomy is recognized as one of the most serious problems in modern gastric surgery. Of the late complications following gastrojejunostomy, none is more disappointing or feared than the development of jejunal ulcer which is the preceding lesion of gastrojejunocolic fistula. A review of the literature reveals that the average case of gastrojejunocolic fistula occurs between four and one-half and nine years following the gastro-enterostomy, while a few cases have been reported as early as six weeks following surgery and some, eighteen years later. We (M. B.) have had the opportunity of seeing a case of duodenal ulcer in 1919 at which time a partial gastrectomy was performed and followed by a posterior gastro-enterostomy. The patient had no difficulty following this surgical procedure until twenty-one years later. In January, 1940, an exploratory operation was performed, and the patient was found to have a gastrojejunocolic fistula. The subject of gastrojejunocolic fistula should be of interest to all of us, and in view of the fact that so few cases are reported in the literature, we have taken the liberty of briefly reviewing the incidence, etiological factors, pathology, symptomatology, diagnosis, and treatment of this condition.

The first gastro-enterostomy was performed by Wolfer (11) at the suggestion of his assistant, Nicoladini, as recently as the year 1881. Braun (78), in 1899, reported the first case of gastrojejunal ulcer. A point of interest here is that the first case of gastrojejunal ulcer to be reported was one in which acute perforation took place. Goeppel (73) reported the first successful suture of acute perforation of gastrojejunal ulcer in 1902. The first case of gastrojejunocolic fistula following gastro-enterostomy was reported by Czerny (11) in 1903. A resection "en bloc" was made of the stomach, jejunum, and colon, and the gastro-enterostomy was successfully completed. In one of the earliest comprehensive papers on the subject, Paterson (56), in 1909, originated the term "gastrojejunal ulcer." In 1912, Haudeck (29) made the first roentgen-ray diagnosis of gastrocolic fistula caused by a carcinoma of the stomach. Verbrugge (75), in 1924, collected 202 cases of gastrocolic and gastrojejunocolic fistulas from the literature after a most thorough review and added 14 new cases from the Mayo Clinic which were reported by Mayo and Rankin (49) in 1921, which made a total of 216 cases. Fardelmann (17), in 1937, made an additional review of the literature and stated that a total of 229 cases had been reported from 1903 to 1930. Since then, in so far as we have been able to ascertain, 92 cases have been reported by various authors. With the case we are reporting, a total of approximately 322 cases have been reported up to the present time.

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### INCIDENCE

It is difficult to determine the incidence of gastrojejunocolic fistula because it is known that many of the observed cases have not been reported or diagnosed, and it is readily admitted by those who have written on this subject that it is not possible to determine the frequency of gastrojejunal ulcer. It is interesting to observe that a gastrojejunocolic fistula practically never occurs in women and of 52 cases of fistula reported by Judd (32) in 1935, only 1 was that of a woman. Lahey (35) agrees with Judd and adds that women have lower acid values than men, and that fistula almost never occurs following gastro-enterostomy for carcinoma of the stomach. He further reports that the incidence of fistula communication with the colon in cases of gastrojejunal ulcer is 8.7 per cent. Balfour and Down (5) report the incidence of gastrojejunal ulcer with impending colic fistula in a series of 500 cases to be 3.26 per cent. Strauss, Block, and Friedman (70) report a 24 per cent incidence of gastrojejunal ulcer developing after gastro-enterostomy and state that 90 per cent of the ulcers are duodenal and 10 per cent are gastric in origin. This is quite suggestive in view of the high acid values in duodenal ulcer and the low values in gastric ulcer. Jordan (30) states that most cases of jejunal ulcer occur after gastro-enterostomy for gastric ulcer, but that they are almost unheard of after operation for carcinoma of the stomach, although Judd has re-

ported a case. Lewisohn (38), in 1925, published a series of 68 cases of gastro-enterostomy in which 23, or 34 per cent, of the patients developed gastrojejunal ulceration after having been watched for a period of not less than five years. Hurst and Stewart (29) give a 52 per cent incidence for 42 cases examined from nine months to nineteen years after the operation. These, however, were selected cases, for the examinations were carried out after the patients had died and therefore no cognizance was taken of the patients who had recovered and who might constitute a higher percentage of the total number operated upon.

Verbrugge (75) believes that fistulas due to carcinoma of the colon and stomach are decreasing whereas fistulas due to gastro-enterostomy are increasing. Most authors agree with Pratt (62) that jejunal ulcer following gastro-enterostomy practically always occurs in the group of patients whose original trouble was a duodenal rather than a gastric ulcer. The British Medical Association studied 744 cases for a period of from two to four years and reported an incidence of 2.8 per cent. The Germans report 5 per cent. Mayo and Rankin (49) report from 1 to 3 per cent. Paterson (57) reports 2.4 per cent in 495 cases. Lord Moynihan (53) reports 1.6 per cent in 613 cases. Walton (78), in 1930, reported 616 gastro-enterostomies, of which 16 (2.6 per cent) were subsequently followed by gastrojejunal ulcer.

Most authors state that recurrence is more frequent after anterior gastro-enterostomy. However, Walton (78) found 29 gastrojejunal ulcers in 1,313 posterior anastomoses, while in following up 33 patients with anterior gastro-enterostomy he found no marginal ulcers. Jordan (30) states that it seems evident, therefore, that the reported incidence of gastrojejunal ulcer will vary and depends upon such factors as the length of the follow-up period, the care with which patients are observed after the operation, the nature of the original lesion and the associated gastric phenomena, the race of the patient, the quality of the surgical technique, and the presence of foci of infection or other etiological agents.

### AGE AND SEX

The age in which fistulas occur is the age during which ulcers usually develop. The youngest patient reported by Roux (75) was twenty years of age and the oldest sixty-six years. The Mayo Clinic reports that the age incidence is between twenty-seven and sixty-one years, and that all of their patients were males but 1. Rife (65) reports his youngest patient to be thirty-one and the oldest seventy-two, and that the development of definite symptoms of fistula varied from six months to eleven years with an average interval of four and one-half years. It is interesting to note that of his 13 patients with fistula following gastrojejunal ulcer, 2 were women—an incidence of about 15 per cent. Eusterman (15) states that the proportion of males to females affected with gastric and duodenal ulcers is 3 to 1 and the proportion affected with jejunal ulcers is 6 to 1.

### ETIOLOGY

Gastrojejunal ulcer has been named as the primary etiological factor in gastrojejunocolic fistula. The original lesion in most instances is a duodenal ulcer. Among the many theories which have been advanced as the cause for the development of gastrojejunal ulcer are: (a) focal infection (trauma, tuberculosis, syphilis); (b) marked hyperacidity, which causes the alteration in physiology brought about by the contact of an acid medium with the jejunum which is accustomed to an alkaline medium (Mann and Williamson, 45); (c) operative trauma to the mucosa by the use of anastomotic clamps which cause pressure; (d) use of non-absorbable sutures and Murphy buttons. (The substitution of absorbable catgut ligatures for silk sutures failed to prevent the condition); (e) foreign body inclusions, such as suture material in the line of sutures, which cause devitalization of the suture line (Balfour, 4), although Lahey and Swinton (37) do not believe that non-absorbable suture material is responsible for the production of anastomotic ulcer; (f) indiscretion in diet too soon after an operation; (g) carelessness in medical supervision; (h) excessive smoking, alcoholism, and the use of condiments; (i) fatigue or exposure; (j) arteriosclerosis; (k) breaking down of hematomas; (l) faulty technique—particularly, placing the anastomosis too high, the posterior anastomosis being made too low through the opening in the mesenteric leaf of the transverse colon (the opening should be high, but not impair the blood supply to the colon; the completed anastomosis should be kept away from, and should not rest on the transverse colon) (28); (m) resection after gastro-enterostomy, which is prone to be followed again by ulcer (particularly after von Eiselsberg pyloric exclusion operation), and (n) the same causes that produced the original ulcer.

### PATHOLOGY

Fistulas, in cases of carcinoma of the stomach or colon, are part of the tumor itself, and the

tract is lined with cancerous cells, the size, shape, direction, and number of which vary with the tumor. The fistulas resulting either from a jejunal or peptic ulcer correspond to a fairly well defined type. They may be gastrocolic, jejunocolic, or gastrojejunocolic. There is usually localized peritoneal reaction, and there may or may not be extensive adhesion formation. Fistulas are single, almost without exception although cases of multiple jejunal ulcers have been reported. The direction, length, and width of the fistulas are variable. The orifice may be hidden in the folds of the mucosa, which creates a valve-like apparatus that causes regurgitation from the colon to the jejunum, and thus gives rise to symptoms of undigested food in the fecal material and eructations of a foul nature. The mucous membrane of the fistulous tract is usually not markedly abnormal. The surface has a smooth, glistening appearance and the glands are regularly disposed. There is usually no ulceration of the mucous membrane. The edges on the intestinal side are smooth, those on the colon side may be slightly indurated (75).

## SYMPTOMS

The onset of the symptoms of fistula varies because the period of evolution of gastrojejunocolic fistula is preceded by the symptoms of the associated lesion. Preceding the period of formation of a fistula there is usually an interval of several years during which time an ulcer develops, followed by a subsequent gastro-enterostomy for the relief of the ulcer symptoms. Eventually, a jejunal ulcer may form and, finally, a fistula. Balfour (4) reported that in 56.7 per cent of the cases of gastrojejunal ulcer the symptoms reappeared in one year, although in 1 case the postoperative interval was twelve years. The average length of time between the primary operation and the development of gastrojejunal ulcer was four and one-half years. Lahey (37) reported a case in which a gastrojejunal ulcer and its associated symptoms appeared nineteen years after operation on a duodenal ulcer.

*Diarrhea.* The most constant and significant symptom of fistula is frequent defecation. The stools may be watery, semi-solid, fatty, or lienteric. The patient may have from six to ten yellow, soft stools daily with a strong foul odor. The stools are usually acid in reaction because of either gastric secretions or fatty acid. The diarrhea does not respond to any medication although it may be alleviated by the use of a high residue diet. Because of this constant diarrhea the patient suffers from a loss of general good health, and marked emaciation of the patient ensues. Many authors (18, 65, 75) believe that the persistent diarrhea is caused by the passing of undigested food through the stomach into the transverse colon.

*Eructation.* The belching of gas with fecal odors occurs in most cases. The fecal odor is extremely disagreeable to the patient even though it may not be noticed by others. Enemas or the injection of air into the rectum for diagnostic purposes aggravates the condition. Some patients can taste medicine which has been instilled rectally. The eructations usually disappear only to recur with the next episode of diarrhea.

*Vomiting.* It is not common to find vomiting in these patients and it is unusual to find actual fecal vomiting. Vomiting is increased by large enemas and decreased by frequent gastric lavage and by the administration of a constipating diet. In the absence of intestinal obstruction vomiting of fecal material is pathognomonic of the disease.

*Pain.* This symptom is rare and not dependable and the site of the pain is variable. Eusterman (15) states that in 85 per cent of the cases the pain may be farther to the left and lower than the original pain. It may be sharp and burning; usually it is circumscribed or in the left iliac region, but, as a rule, there is very little pain present. If there is an associated intestinal obstruction there may be severe pain. If a gastrojejunal ulcer exists and is about to perforate there is usually severe pain, but with the establishment of a fistula, pain often ceases.

*Loss of weight.* The loss of weight is very marked and is quite rapid in spite of unimpaired or increased appetite and intake of food. Patients usually become emaciated, dehydrated, and weak, and thereby increase the surgical risk. Occasionally an associated nutritional edema of considerable severity may exist. Cachexia with weakness and weight loss can usually be found in over 90 per cent of the patients, according to Poynton and MacGregor (61).

*Physical findings.* The physical signs are never constant in their appearance. On examination, the greatest tenderness and rigidity may be found in the left lower quadrant of the abdomen because if fluid escapes from a perforation of a gastrojejunal ulcer it usually passes downward at the left of the vertebral column. A mass is seldom felt on abdominal palpation and if one is present it is usually due to extensive adhesions or regional inflammation. It is difficult to determine by physical examination whether one is dealing with a large or small fistula. It is known that when a large fistula exists, diarrhea occurs soon after

the ingestion of food. If a small fistula exists and communicates with a distant segment of bowel then the cardinal symptoms are intermittent for the fistulous tract may close for a time and allow normal bowel movements, only to be reopened and cause a reappearance of the symptoms. Active peristalsis may be present.

### DIAGNOSIS

The diagnosis of gastrojejunocolic fistula is usually based on a history of ulcer symptoms followed by gastro-enterostomy from which the patient obtains relief for a period varying from one week to ten years but usually from six to twelve months. This is followed by a period of intermittent diarrhea associated with fecal-smelling eructations and, finally, marked wasting, emaciation, cachexia, and dehydration. Undigested food may be found in the stool very soon after ingestion if the fistulous tract is large and medication which is instilled rectally may be tasted soon after instillation. Similarly, meals colored by dye, such as carmine or charcoal, may appear in the stool and colored enemas may be recovered by gastric lavage.

Roentgenological examination (3, 10, 25, 41, 43, 66, 79) is another aid in establishing the presence of a fistulous communication between the stomach, jejunum, and colon. If barium can be seen to enter the colon shortly after escaping from the stomach the diagnosis of gastrojejunocolic or gastrocolic fistula can be made with certainty.

### DIFFERENTIAL DIAGNOSIS

The principal pathological conditions which must be considered in differential diagnosis are intestinal obstruction and acute peritonitis.

The symptoms of acute obstruction are: (a) sudden abdominal pains, at first paroxysmal but later continuous; (b) constipation, soon becoming absolute; (c) vomiting, persistent, and ultimately of a stercoraceous character; (d) abdominal distention; (e) visible peristaltic waves; (f) collapse indicated by pinched features, sunken eyes, a cold clammy skin and a frequent, feeble pulse; and (g) toxemia characterized by a decrease in the chlorides of the blood and an increase in the carbon-dioxide combining power of the blood, and an increase of the blood urea. Roentgenograms will reveal the condition.

Peritonitis is characterized by: (a) intense abdominal pain and tenderness; (b) shallow and thoracic breathing; (c) the position of the patient —to relieve the tension of the abdominal muscles he lies motionless upon his back with the legs and thighs flexed; (d) pinched features and anxious expression; (e) a distended abdomen with rigid walls; (f) dullness in the flanks upon percussion; (g) usually a moderately high temperature from 102 to 103° Fahrenheit; (h) vomiting and hiccough (these are common symptoms); and (i) a high leucocyte count, from 15,000 to 50,000. Collapse may occur.

### PROGNOSIS

The outcome of a gastrojejunocolic fistula is usually fatal unless surgery intervenes. It has been reported that recurrences of jejunal ulcer occur in from 40 to 60 per cent of the cases and, thus, it is no wonder that such an experienced operator as Lahey wrote: "I approach gastrojejunal ulcer with colonic fistula with hesitation and fear as to the question of possible fatality."

### THE PREVENTION OF GASTROJEJUNAL ULCER AND RECURRENT GASTROJEJUNAL ULCER

Jordan (30) believes that prevention of gastrojejunal ulcer and recurrent gastrojejunal ulcer is likely to be unsatisfactory until we determine the ultimate causative factors of the ulcer and establish effective curative and preventive treatment based upon knowledge of the etiology or pathogenesis. Lacking such important knowledge, the surgeon today would gain tremendously if it were possible to decide in advance which patients will develop gastrojejunal ulceration after gastroenterostomy. Much work along these lines has been done, but it must be admitted that our knowledge is still incomplete and quite inadequate.

Toland and Thompson (73) believe that until the problem of the etiology of primary peptic ulcer is solved, it is not likely that the cause of secondary gastrojejunal ulcer will be found. Despite our lack of knowledge as to the direct or ultimate cause of gastrojejunal ulcer two very important facts stand out. One is the peculiar susceptibility of the jejunum (the tissue susceptibility factor of Ochsner and his coworkers, (54) to the influence of gastric juice. The other is the marked tendency of gastrojejunal ulcer to penetrate or perforate. The latter is attested to by the high frequency of subacute perforation of the gastrojejunal ulcer and by the frequent occurrence of gastrojejunocolic fistula. Lahey and Swinton (37) believe that gastrojejunocolic fistula with its high mortality is anatomically less apt to occur after anterior gastro-enterostomy than after posterior gastro-enterostomy, and should gastrojejunal ulcer occur after anterior gastroenterostomy, it would be definitely easier and safer to manage it surgically from a technical

point of view than gastrojejunal ulcer following posterior gastro-enterostomy.

### TREATMENT

Surgical intervention offers the only hope and is the treatment of choice for this condition. The patient, as a rule, however, is a very poor surgical risk. Usually he is dehydrated, emaciated, and anemic. Surgical shock, hemorrhage, peritonitis, or infections of the respiratory tract are the chief dangers. The object of all treatment, whether it be medical or surgical, is to restore the patient's normal physiological balance and to preserve as far as possible his designed anatomical conformation in order to bring back normal health.

One must remember that abdominal surgery involves a great deal of danger because of the possibility that severe peritonitis may follow surgical procedures, and when the gastrojejunal ulcer is complicated by a fistulous tract leading to the colon the surgical work is increased and the dangers of peritonitis from fecal contamination are very great. Cushing, as reported by Findlay (18), has shown that gastric and duodenal contents are relatively sterile and that bacteria increase in number and virulence down the intestinal tract. It is well known that peritonitis from the spill of normal gastric or duodenal contents is rare, while the slightest contamination of the abdominal cavity by the contents of the large intestines results in peritonitis which is usually fatal to debilitated patients.

Operative procedures should be as simple as possible and certainly no routine operation can be performed equally well for all fistulas. The simple closure of the fistula and the undoing of the gastro-enterostomy with the creation of a new gastro-enterostomy has given the best results. In some cases, if a marked stricture has taken place, resection of the colon is necessary. Graham and Lewis (27) believe that the ideal operation for a gastrojejunocolic fistula is a block resection of the stomach, jejunum, and colon with triple anastomoses, together with cecostomy. Balfour and Down (5) state that their experience has shown that the gastrojejunal ulceration can be excised and the anastomosis disconnected with a mortality rate of 1 or 2 per cent, or if partial gastrectomy also appears to be indicated, the mortality rate will be 4 or 5 per cent. According to Lewisohn (38), it is assumed by many surgeons that pylorectomy will prevent the formation of gastrojejunal ulcers. This opinion, which is often expressed in the literature, is erroneous. Gastric resection should never consist in simple pylorectomy. Only partial or subtotal gastrectomy will reduce the incidence of postoperative gastrojejunal or jejunal ulcers to a minimum. Jordan (30) believes that the incidence of recurrent gastrojejunal ulcer after partial gastrectomy is low, probably about 0.5 per cent, but it is important to know that it does occur and that the mere recovery of the patient from the operation does not always mean a successful future. Partial gastrectomy, therefore, may be considered the best of the available methods of surgical treatment, but it cannot be accepted as final or a wholly satisfying solution. Among the sequelæ of partial gastrectomy may be mentioned anemia, gastro-intestinal motor disturbances, nutritional impairment, and a hypoglycemic state.

According to Lowey's statistics on 63 operations of all kinds, there were cures in 61.9 per cent, recurrences in 11.1 per cent and deaths in 27 per cent. Lahey (37) reports a 15 per cent mortality. At the Mayo Clinic (49) operations were performed in 20 of a series of cases; in 4 partial resection of the transverse colon was done; in 15 the fistula was closed; in 11 the old gastro-enterostomy was cut off; in 4 a new one was made; in 2 the old gastro-enterostomy was reëstablished; in 3 partial resection of the jejunum was performed; in 2 pyloroplasty was performed; and in 1 jejunostomy and cecostomy were done. There was a mortality rate of 20 per cent, 2 patients dying after resection of the colon for carcinoma, 1 dying from acute nephritis two years after the operation, 1 from general peritonitis and bronchial pneumonia and 1 from an indefinite cause.

Findlay (18) has used the Mikulicz operative procedure in selected cases with good results. Lahey and Swinton (37) have a two-stage operation which appears to be an ideal procedure for gastrojejunocolic fistula but it is a procedure of too great magnitude to be routinely applicable to this condition with a reasonable mortality.

The importance of pre-operative treatment cannot be overemphasized in patients who are to undergo major gastric surgery. The water balance must be reëstablished; the acidosis must be combated with dextrose and intravenous solutions; transfusion of whole blood may be necessary; and the ingestion of large quantities of fruit juices and carbohydrates, along with the administration of minerals and vitamins is essential. All these procedures are necessary so as to return the patient to as normal a condition as possible. Postoperative care is likewise important. The patient should be placed on a strict diet following surgery whether it be partial gastrectomy or gastro-enterostomy. Alcohol, tobacco, and condiments must be avoided. The proper administration of

alkalies is important. There should be moderation in habits and in living, and, finally, these patients should be observed carefully so that any recurrence of ulceration may be detected.

## CONCLUSION

A collective review of the literature revealed that 322 cases of gastrojejunocolic fistula have been reported since 1893. The interval between gastro-enterostomy and the development of gastrojejunocolic fistula varied considerably, the shortest being six weeks and the longest eighteen years. We had a case in which gastrojejunocolic fistula occurred twenty-one years following a gastro-enterostomy for duodenal ulcer. The etiology, pathology, symptomatology, differential diagnosis, and treatment are discussed. No definite surgical procedure is favored, but it has been found that partial gastrectomy followed by excision of the fistula, taking down of the old gastro-enterostomy, and then reconstruction of the gastro-intestinal tract is the operation which has given the best results to date and should be replaced by more simple methods only if the condition of the patient will not warrant its use. The evolution of the fistula is progressive, and unless surgical intervention is undertaken, the outcome is usually fatal.

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# SURGERY OF THE ABDOMEN

## GASTRO-INTESTINAL TRACT

**Gray, H. K., and Skinner, I. C.: The Operative Treatment of Cardiospasm.** *J. Thoracic Surg.*, 1940, 10: 220.

Cardiospasm is the term most frequently used to imply spasm of the musculature of the cardia or epicardia sufficient to prevent completely or partially the passage of food from the esophagus into the stomach.

The etiology of cardiospasm is still in dispute. The disease has been attributed to primary atony of the musculature of the esophagus, to spasm of the cardia, to failure of proper relaxation of the cardiac sphincter, to spasm of the diaphragm, to pressure on the esophagus by the left lobe of the liver, to kinking of the esophagus, to pressure from the lower lobes of the lungs, to fibrosis of the periesophageal connective tissue, and other conditions. Recent pathological and experimental work has made the theory of autonomic imbalance the most acceptable one.

A study of the gross pathological changes of the esophagus produced by cardiospasm demonstrates why in all cases the condition is not amenable to simple dilatation. The characteristic gross pathological changes seen are dilatation of the esophagus, hypertrophy of its wall, and actual lengthening of the organ with resultant tortuosity. The dilatation usually assumes one of three typical shapes: fusiform, flask-shaped, or sigmoid-shaped. In the fusiform variety the lumen of the esophagus increases to a point midway between the cricoid cartilage and cardia, then gradually decreases in size; in the flask-shaped type the dilatation is immediately above the cardia. In both of these varieties the cardia is the most dependent portion of the dilated esophagus and both are readily relieved by dilatation from above.

The sigmoid-shaped esophagus represents an advanced pathological change and, fortunately, is the rarest type.

The symptoms of cardiospasm are characteristic of the stage of the disease. There are three stages, more or less clearly defined, in the clinical course of the disease: (1) cardiospasm without regurgitation of food; (2) cardiospasm with immediate regurgitation of food; and (3) cardiospasm with a dilated esophagus and retention of food in the dilated part—this undigested food is regurgitated at varying intervals. The characteristic symptoms are dysphagia, regurgitation, and epigastric pain. Respiratory disease may result from inspiration of the contents of the esophagus. Dysphagia is usually of long duration and is as marked for liquid as for solid foods. Regurgitation may occur immediately after meals or may be delayed for hours; this depends on the amount of food taken, the degree of dilatation, and the tone of the esophagus. Nocturnal regurgitation is a particularly disturbing feature. Epigastric and substernal pain may precede the appearance of dysphagia by many months and must be differentiated from that caused by disease of the biliary tract, angina pectoris, peptic ulcer, and paraesophageal hernia.

Dilatation of the cardia from above by some type of mechanical dilator is an extremely satisfactory method of treatment in most cases of cardiospasm. Of more than 1,200 cases of cardiospasm in which the patients were encountered at the Mayo Clinic, only 7 were treated by operative measures. Esophagogastrostomy seems to be a very satisfactory operation in certain cases in which cardiospasm is resistant to treatment by dilatation.

For the debilitated patient, preliminary gastrostomy or jejunostomy has been recommended for feeding purposes prior to the more extensive operation. At other times it is feasible to perform gastrostomy at the time of the major procedure, and thus avoid the increased difficulties of separating adhesions and the necessity of performing two operations. Satisfactory exposure can be obtained through a left rectus incision which begins in the left costo-ensiform angle and extends a little beyond the umbilicus. If necessary, the left lobe of the liver can be mobilized easily by severing of the left lateral ligament, and it can then be conveniently packed away to the right beneath the abdominal wall. The spleen is retracted downward and to the left by a large, specially designed retractor. It is probable that preliminary interruption of the left phrenic nerve, as in cases of diaphragmatic hernia, would facilitate the operation, although the authors could find no report in the literature in which this had been done.

When satisfactory exposure has been obtained, the stomach is drawn well down by means of a right-angled rubber-covered clamp, and the abdominal portion of the esophagus which is covered with peritoneum is brought into view. The peritoneum is divided at the point where it is reflected from the diaphragm onto the esophagus. Vessels running along the anterior margin of the hiatus should be avoided. A finger is introduced into the mediastinum and as much of the thoracic portion of the esophagus as possible is mobilized. To accomplish this, the esophageal hiatus may be split a short distance to the left. The finger is then hooked around the freed esophagus and the latter is drawn down into the abdomen as far as possible. There is rarely difficulty in obtaining sufficient length of esophagus, particularly when the esophagus has assumed the sigmoid shape, as the organ usually has become lengthened as a result of the disease. The esophageal hiatus is attached high along the esophagus by interrupted silk sutures to prevent retraction of the

anastomosis into the thorax and to lessen the likelihood of soiling the mediastinum at the time of the anastomosis. The anterior portion of the fundus of the stomach is anastomosed to the redundant esophagus as in gastro-enterostomy. The incision in the esophagus may be extended in an arc through the cardia and the union accomplished in the manner of a Finney pyloroplasty. The left lobe of the liver falls into place over the suture line and adds to its security. A drain may be placed down to the anastomosis if there is fear of contamination.

The nerve supply of the cardia has been attacked by several operative procedures in an attempt to relieve cardiospasm.

In the opinion of the authors, surgical procedures will be found necessary at times in those few cases in which the esophagus is markedly dilated, tortuous, and lengthened with angulation at the cardia, and in which development of a reservoir below the level of the opening of the cardia has occurred.

**Agati, D.: Roentgen Aspects of Gastrogastric and Gastroduodenal Invagination** (Quadri radiologici di invaginazione gastro-gastrica e gastro-duodenale). *Radiol. med.*, 1940, 27: 865.

Pure gastrogastric invagination is extremely rare and may be ascending or descending, the first being more frequent than the second; in fact, the Italian literature mentions 5 cases of the former, 3 of which are questioned, and only 1 case of the latter. It would seem that the determining factor of the ascending form is the presence of organic lesions in the antral region, especially annular neoplastic infiltration; while that of the descending form is the presence of endogastric tumor, usually a polyp. Gastroduodenal invagination is more frequent and is due to a benign tumor which is usually located near the pylorus and, under the influence of peristalsis, forces the pyloric ring and penetrates more or less deeply into the duodenum, pulling with it the gastric wall on which it is implanted.

Agati reports 3 personal cases. The roentgen findings of the first case differ from those described by other authors. The latter observed a shortening of the gastric shadow, which is cut off by a filling defect presenting a picture of pincers with a distal concavity for the ascending form and a proximal concavity for the descending form and with evidence of the lumen of the invaginated portion. In the author's case, there is a filling defect with two pictures of pincers, one limiting the lower part of the gastric body and opening distally, and the other limiting the upper part of the antrum and opening proximally; the two concave defects do not correspond exactly in the vertical sense, as the lower branch of the pincers of the gastric body is introduced in the concavity of the antrum, while a trace of opaque substance leaves the center of the concavity of the gastric body to run toward the antrum and disappear in the opacity of the latter. This picture is interpreted as that of an ascending gastrogastric invagination, altered by perigastritic processes; it gives the impression that the two concave pictures are encased one into the other as if there were a double, an ascending and a descending, invagination.

In the second case, the invagination is short because the concavity opening distally and limiting the gastric body is little marked and has a large radius; its lower branch ends with a pseudodiverticular sac. In the center of the pincers, there is a large pedicle corresponding to the invaginated part which is kept distended by the polyp that fills the entire antropyloric portion. The diagnosis of ascending gastrogastric invagination was confirmed at operation.

The third case is one of gastroduodenal invagination. The characteristic finding is the presence of an oval defect involving the bulb and having irregular borders. The immediately prepyloric portion always appears spastic and projects the picture of its folds on the bulbar defect, but the picture, which is quite abnormal and has an areolar aspect, suggests a juxtapyloric polypous gastritis which is probably the cause of the invagination. In the presence of such bulbar defects, the differential diagnosis must take into consideration the well known aspects produced by the pyloric eminence in the duodenum (defect on the pyloric side with transparent dome, rosette, and cloverleaf pictures), especially if taken in profile, in which case a tumoral defect, the frontal appearance of a niche, or an invagination may be simulated.

The diagnosis of the first and third cases is presented as one of probability, as neither case has been submitted to operation. RICHARD KEMEL, M.D.

**Chaffin, L.: Surgical Emergencies During Childhood Caused by Meckel's Diverticulum.** *Ann. Surg.*, 1941, 113: 47.

Meckel's diverticulum represents a remnant of the omphalomesenteric duct. Generally, the structure has vanished by the time of birth, but whenever it persists, it becomes a menace to health.

The term "duplex ileum" is applicable to a large intramesenteric diverticulum. A true diverticulum represents a continuation of the intestine, and its walls contain the same histological structures as those of the intestine. A false diverticulum, on the contrary, does not possess a muscular coat.

Complications of this vestigial structure include hemorrhage, ulceration, perforation, peritonitis, intussusception, volvulus, intestinal obstruction, umbilical sinus, and umbilical fecal fistula. Gangrene in one instance occurred during intra-uterine life, causing so-called "meconium peritonitis."

Heterotopic gastric mucosa is often found in these diverticula and may give rise to ulceration, which in turn may cause hemorrhage, perforation, and peritonitis. Ulceration has also been observed in diverticula when no trace of gastric mucosal histology was demonstrable.

Meckel's diverticula have been found among the contents of hernial sacs. So variable are the complications that every preliminary diagnosis of an ab-

dominal emergency in children should take into account a persistent diverticulum as a basic factor, and at the time of operation exploration should always establish the presence or absence of the structure. Most significant among the subjective symptoms are pain, nausea, and vomiting, sometimes constipation, but more often small evacuations containing blood. The blood count is helpful only when integrated with the facts gathered from the history and physical examination. Roentgenography has a very limited usefulness.

Among 19 cases in this series, there were 7 deaths, a mortality of about 37 per cent. The youngest patient was a newborn infant, the oldest a child of eight years. Inversion of the stump with a purse-string suture, which was responsible for 1 fatality, is a hazardous procedure in children, because the subsequent edema may completely block the lumen of the intestine. HAROLD LAUFMAN, M.D.

**Selberg, W.: Carcinoid of the Bowel** (Ueber das Carcinoid des Darmes). *Arch. f. path. Anat.*, 1940, 306: 467.

Carcinoids, which are usually benign tumors arising from the chromaffine cells in the intestine, have been differentiated from malignant growths since 1907, and have been frequently described from the pathological aspect, but rarely from the clinical. The author has seen 53 cases in 14,000 autopsies and 2 operative specimens during the past six years. (Carcinoids of the appendix are not included.) In this series, there were 53 carcinoids in the small bowel, 1 in the cecum, and 1 in the rectum. Ten of the tumors had metastasized. Several characteristic histories are presented, and the findings compared with those in the literature.

The average age of the patients is sixty-six years; and the carcinoids are found in 0.6 per cent of those over fifty years old and in 0.1 per cent of those under fifty. The incidence is the same in the two sexes. The tumors are most often found in the lower small intestine, and are frequently multiple. Clinical manifestations are produced only by the malignant carcinoids and the very large benign ones. They may either become large enough to materially narrow the lumen or smaller pedunculated ones may lead to intussusception. The infiltrating, proliferating type may cause contractionand stenosis. Malignant carcinoids are the most common malignant tumors of the small bowel, where malignant tumors, in general, are very rare. They differ favorably, however, in growth and malignancy, from carcinomas and sarcomas. The primary tumor is often small, and metastases are found in the mesentery, lymph nodes, liver, and, relatively frequently, in the spleen.

As to their etiology, Feyrter found a substance in carcinoids and in chromaffine cells which affects the blood pressure and blood sugar, and, therefore, he ascribes the origin of carcinoids to a general disturbance of the internal secretions. The author was unable to confirm this. He found, as the only predisposing factor, a tumor tendency. Inasmuch as carcinoids grow so slowly, resection of the primary growth may, in spite of metastases, prolong life, in most cases for years, as is indicated in several of the case histories presented by the author.

(BEYER). LEO M. ZIMMERMAN, M.D.

**Garlock, J. H.: The Surgical Treatment of Intractable Ulcerative Colitis.** *Ann. Surg.*, 1941, 113: 2.

Between 10 and 20 per cent of the patients with ulcerative colitis resist every form of medical treatment, the condition progressing to irreparable involvement of the colon. The surgical treatment in the past consisted of appendicostomy, cecostomy, and, occasionally, colostomy. These procedures do not completely divert the fecal stream from the diseased bowel.

It is now agreed that surgical treatment is indicated under the following conditions: (1) uncontrollable hemorrhage; (2) acute ulcerative colitis with profound toxemia; (3) impending perforation; (4) chronic colitis resisting all forms of medical therapy; and (5) segmental ulcerative colitis.

Early performance of ileostomy when these conditions are present is a life-saving measure. Ileostomy is to be considered as the first step of a graded multiple-stage operation involving subtotal resection of the colon. When segmental colitis is present, the plan of procedure will depend upon the general condition of the patient and the site of involvement of the colon. In such cases, when the left colon and rectum are involved, a transverse colostomy must be seriously considered in preference to an ileostomy. This is followed at a later date by removal of the diseased left colon. If the rectum is free of disease, an ileoproctostomy, with transection of the ileum and colon proximal to the site of the disease, is the preliminary procedure of choice. If the right colon is involved, an ileosigmoidostomy with transection of the colon proximal to the anastomosis is performed.

In performance of an ileostomy the colon should not be touched. Many of the reported deaths after ileostomy may be attributed to ill-advised exploration of the colon. In the author's opinion ileostomy should in no sense be considered a curative operation. Active disease may still be present in the colon eighteen months after its exclusion by ileostomy. Reëstablishment of continuity of the ileum is fraught with great danger. It is wise to defer resection of the colon until the maximum improvement has been obtained, usually from six to twelve months.

If proctoscopic examination reveals a normal rectum and lower sigmoid, an anastomosis between the ileum and the anterior wall of the rectum should be done. When dealing with bowel of an ulcerative colitis case, no blind ends should be dropped into the abdomen; the divided ends should be implanted into one angle of the incision as a colostomy opening. The next stage, which is carried out after two or three months, consists of removal of the sigmoid, descending colon, splenic flexure, and left half of the transverse colon. The final stage consists of removal

of the terminal ileal fistula and the remainder of the colon.

The author believes that unless the rectum is hopelessly diseased by pseudopolypoid degeneration, or by the presence of numerous fistulas, it will eventually heal and permit restoration of normal elimination. Thus, the rectum is not removed by abdominoperineal resection, which preserves that organ for possible future use in the reëstablishment of intestinal continuity.

Fifteen of 25 surgically tested patients had ileostomies. There were 5 deaths in the series of 25 patients, a gross mortality of 20 per cent. In 4 instances an error of technique or judgment was responsible for the mortality, but with increasing experience the author believes that such errors will become less frequent. HAROLD LAUFMAN, M.D.

**De Morais, V.: Cancer of the Rectum** (Sôbre cancro do recto). *Arq. de patol.*, 1940, 12: 221.

De Morais states that cancer of the rectum includes any malignant tumor of this organ, whether of epithelial or connective-tissue origin. Rectal carcinoma occurs frequently, constituting 5 per cent of all carcinomas observed, while rectal sarcoma is rather rare. Various etiological factors have been incriminated for the appearance of rectal cancer, but without real proof; however, there is a lesion which often precedes the cancer—rectal polyposis. Usually, the carcinoma starts as a single, small nodule in the mucosa which soon becomes ulcerated. There are 3 clinical and anatomicopathological types of rectal carcinoma: supra-ampullar, ampullar, and anal; according to whether they occur in the upper portions of the rectum or in the anal canal, there are two principal forms: cylindrical-celled, including adenocarcinoma, and solid and colloid carcinomas; and stratified-celled, including planocellular, basocellular, and mixed carcinomas. The tumor remains localized to the rectum for a considerable time and then invades the neighboring tissues and organs. Early diagnosis is necessary for efficacious treatment: unfortunately, rectal cancer is one of those diseases which are characterized by a prolonged period of latency during which no important symptoms reveal the disorder. Therefore, the physician must be familiar with the slightest initial symptoms, such as the appearance of a nodule in the rectal mucosa, a change in the intestinal functions, pain after evacuation, hemorrhage, discharge of mucus, obstipation, and dyspepsia. The diagnosis is confirmed by digital examination of the rectum, rectoscopy, roentgen examination, and biopsy. The patient often consults the physician when the disorder has evoluted for several months, and a differential diagnosis must then be made between carcinoma and various other rectal diseases (hemorrhoids, prolapse, rectitis, stricture, syphilis, tuberculosis, Nicholas-Favre's disease, benign tumors, angioma, lymphangioma, adenoma, fibroma, polyp, and papilloma). The complications of rectal carcinoma are caused by its continuous growth, which results in subocclusion of the rectum and destructive invasion of the nearby organs.

When the cancer is generalized and metastases have invaded the internal organs, bones, and skin, treatment is useless and is limited to relieving the sufferings of the patient. When the disorder is still localized, surgical intervention and irradiations are used. The object of surgery is the removal of all cancerous tissue. There are three routes to reach and extirpate the rectum: low (perineal, sacral, perineosacral, vaginal and anal), combined (abdominoperineal, perineo-abdominal and abdominosacral), and high (abdominal). Pre-operative preparation is indispensable to increase the resistance of the patient: several successive blood transfusions of from 200 to 400 c.cm., injections of serum, and physiological salt and dextrose solutions; cardiac tonics, coagulants when indicated, special diet, attention to bowels, vaccinations, disinfection, and care of the mouth. General anesthesia with ether and spinal anesthesia are used; local anesthesia is impractical.

It may be necessary to install an iliac anus; its advantages and disadvantages are discussed. Its technique includes three steps: opening of the abdominal cavity, exposure and fixation of a sigmoid loop, suture of the abdominal wall and opening of the sigmoid.

As an introduction to the discussion of the various surgical interventions in use, the author gives a thorough description of the anatomy of the rectum. Among the low routes of access to the rectum, the perineal requires: (1) incision of the skin around the anus and liberation of the rectum, including the fatty tissue which surrounds it, up to the peritoneum; (2) opening of the peritoneum and exteriorization of the rectum by pulling the pelvic colon down to the wound; and (3) closure of the peritoneum, partial reconstruction of the perineum, and section of the intestine and its fixation to the skin. The sacral route requires: (1) incision of the soft tissues and sufficient bone resection to allow reaching the rectum; (2) liberation of the rectum and pulling down of the colon; and (3) resection and anastomosis of the intestine, and suture of the soft parts. Various modifications of this technique may be advisable, such as temporary bone resection, formation of a sacral anus, amputation of the rectum (perineosacral route). The vaginal and the anal routes have been used in a few cases.

The advantages of preserving the sphincter with its innervation are evident; when this seems possibie, the sacral route must be used. However, the importance of preserving the sphincter should not be exaggerated. When an artificial anus is necessary, the perineal type is the best.

Among the combined routes of access to the rectum, the abdominoperineal and its reverse, the perineo-abdominal, require two stages. The abdominal stage includes: (1) laparotomy and exploration of the abdomen; (2) liberation of the pelvic colon and its mesentery and of the rectum; and (3) pulling down of the colon, peritonization of the pelvis and

closure of the abdomen. The perineal stage includes: (1) incision of the skin and cellular tissue up to the muscles; (2) section of the muscles and liberation of the rectum; (3) pulling down of the colon to the perineum and suture to the skin. A modification of the abdominoperineal method includes hysterectomy: section of the broad ligaments, and dissection of the ureters and liberation of the anterior and lateral aspects of the vagina which are done before the rectum is attended to during the abdominal stage, the uterus being removed during the perineal stage. The abdominosacral route is simply a combination of the abdominal and sacral stages of the previous interventions. The abdomino-anal and the abdominovaginal routes have been abandoned.

The abdominal route requires: (1) laparotomy and exploration; (2) incision of the peritoneum and liberation of the rectum; (3) section of the intestine below the tumor, with closure and peritonization of the lower stump; and (4) creation of an iliac anus above the extirpated tumor and closure of the abdomen.

The postoperative care and the treatment of recurrences are the usual ones.

Irradiation has a secondary value and plays a secondary part in the treatment of cancer of the rectum, because radium and roentgen rays alone cannot cure the disorder, even in its beginning when it presents only a small lesion. It is well known that tumors of highly differentiated cells are radioresistant, while those of undifferentiated cells are radiosensitive. Application of this knowledge to the tumors classified according to Broders' scale shows that those of Grade I are radioresistant, of Grade II less radioresistant, of Grade III slightly radiosensitive, and of Grade IV radiosensitive. The critical use of irradiation causes a decrease in the size of the tumor and in the pain, and arrests hemorrhage, mucopurulent discharge, and even the evolution of the tumor. Some tumors considered as inoperable at first may be so improved by irradiation as to become operable subsequently. Most radiologists recommend pre-operative irradiation, and it may be advantageous to install an iliac anus one or two weeks before the irradiations. Radium is seldom used before operation, but often used in an attempt to cure small lesions and as a palliative measure. It is applied at a distance (telecurietherapy), and on the surface and inside of the tumor. Roentgen irradiation is also a palliative procedure; it is used in inoperable cases, pre-operatively and postoperatively. The methods of Coutard, Holfelder, and Chaoul are recommended. Other palliative measures are discussed.

Only a few dozen cases of sarcoma of the rectum have been reported. Usually, they were seen in the inoperable stage. The treatment of carcinoma applies to them.

The author discusses the conditions of operability which depend on the tumor and on the general condition of the patient, and also the practical aspects of the proposed methods of anesthesia (he prefers general anesthesia with ether) and of the surgical interventions. The natural routes can be used only for small tumors in the anal canal and the lower portion of the rectum. The perineal route gives ample access and rivals the combined routes, but when the sphincter is to be preserved the sacral route is better. In spite of their greater gravity, the combined routes are preferred by many surgeons. The abdominal route has few adherents at present because of its high mortality. In inoperable cases, iliac anus may give a survival of two, three, or more years, and irradiations make the patient's life bearable. A large number of cases is reported.

RICHARD KEMEL, M.D.

## LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

**Berman, C.: The Clinical Features of Primary Carcinoma of the Liver in the Bantu Races of South Africa.** *South African J. M. Sc.*, 1940, 5: 92.

Primary carcinoma of the liver, the rarest tumor among Europeans, is undoubtedly the most frequent form of carcinoma among Bantu and Javanese males, and occurs with great frequency in most pigmented races.

The observation of 66 cases has resulted in dividing them into five clinical groups, according to symptomatology:

Group I. "Frank" cancer (63.6 per cent). The signs and symptoms were referred to the liver from the outset in patients who were previously in good health. The mode of onset was gradual. The symptoms were abdominal pain, asthenia, and dyspnea. The physical signs were loss of weight and emaciation, enlargement of the liver, tenderness of the liver, jaundice (43 per cent), ascites (55 per cent), dilatation of the superficial abdominal veins (19 per cent), edema (29 per cent), and hematemesis in 1 case. Secondary anemia was a frequent feature.

Group II. "Acute abdominal" cancer (9.1 per cent). These patients suddenly developed acute surgical conditions of the abdomen due to rupture of carcinomatous nodules or erosion of blood vessels on the free margin of the liver, without previous awareness of their condition. The mortality was high. Those who survived operation, later developed the clinical picture of "typical" primary liver cancer.

Group III. "Febrile" cancer (7.6 per cent). This is the most rapidly growing form of primary liver cancer. Fever is the salient clinical feature. The symptoms are not unlike those of amebic liver abscess.

Group IV. "Occult" cancer (15.1 per cent). There were no complaints directly attributable to disease of the liver. The disease was discovered either during routine examination or at autopsy.

Group V. "Metastatic" cancer (4.6 per cent). The symptoms due to metastases completely overshadowed the primary lesion in the liver. These were due to secondary deposits in the lungs, ribs, and brain.

The prognosis in all these cases is hopeless, and the duration of the disease never longer than four months. The average length of stay in the hospital was eighteen and two-tenths days. The most rapidly fatal cases occurred in Groups II and III. The treatment was essentially palliative, and was directed toward the relief of pain and discomfort. It is possible that roentgen therapy may prove of value in treatment, but was not tried in these cases. Surgical intervention is impracticable.

HAROLD LAUFMAN, M.D.

**Mirizzi, P. L.: Physiological Sphincter of the Hepatic Bile Duct.** *Arch. Surg.*, 1940, 41: 1325.

Evidence is presented to prove the existence of a physiological sphincter of the hepatic duct above the point of junction with the cystic duct. Contraction of the hepatic duct was observed by taking cholangiograms at the time of operation. This contraction was noted only when the ducts were elastic and thin walled, and not when they were dilated or thickened. Iodized poppyseed oil was injected into the gall bladder at the rate of 1 c.cm. a minute to a total dose of 3 c.cm. in three minutes, and roentgenograms were taken at ten-minute intervals. Overdistention was avoided, because it was found to prevent contraction.

It was found that the contractile mechanism of the hepatic duct functions when the gall bladder empties itself spontaneously. In this phase, the gall bladder, cystic duct, and common bile duct system can be visualized, but the oil does not pass into the intrahepatic branches of the biliary tree. If, however, the gall bladder is compressed after injection, the opaque substance passes violently to the whole biliary tree, to be followed by contraction of the terminal segment of the hepatic duct, which allows the gall bladder, and cystic and common ducts to form a separate excretory system. It was further observed that any resistance at the distal third of the common bile duct causes this duct to empty into the cystic duct and produces contraction of the hepatic duct, which prevents any further reflux of the opaque substance. This shows the indirect protecting rôle of the hepatic duct, which favors repletion of the gall bladder with bile during the intervals of digestion when the papilla of Vater is closed, as well as in any circumstance which changes the internal pressure of the common bile duct.

In a patient having a cholecystoduodenal fistula, who was studied, a portion of the oil passed to the duodenum through the fistula and another portion to the cystic duct and common bile duct system, while the upper branches of the biliary tree were not invaded in spite of compression of the gall bladder. There was sufficient contraction of the hepatic duct in this case to prevent the column of oil from ascending, and the excess passed through the fistula, which played a secondary neutralizing part. The same phenomenon is seen when communication between the cystic duct and duodenum is artificially established.

Longitudinal section of the hepatic duct suppresses its defensive contraction and thus favors duodenobiliary regurgitation. Consequently, the integrity of the hepatic bile duct must be respected in making a biliary-intestinal anastomosis.

S. LLOYD TEITELMAN, M.D.

**Weimershaus, P.: A Review of the Cases of Pancreas Necrosis and of Chronic Pancreatitis and Their Late Results at the University Surgical Clinic at Jena During the Years 1920 to 1937** (Zusammenstellung der Pankreasnekrosen und der chronischen Entzuendungen des Pankreas und ihre Spaetergebnisse an der Chirurgischen Universitaets Klinik zu Jena in den Jahren 1920 bis 1937). Jena: Dissertation, 1939.

Weimershaus reviews all the cases of pancreatic necrosis and chronic pancreatitis which occurred at the Jena surgical clinic during the years from 1920 to 1937. There were 52 cases, 44 treated operatively, and 8 conservatively without operation. Of the patients who were operated upon 16 died. This is an operative mortality of 38.09 per cent for the cases of pancreatic necrosis. Only 9 of the patients were men, and 43 were women. Two of the patients were between twenty and thirty years of age; 8 between thirty and forty; 13 between forty and fifty; 15 between fifty and sixty; 12 between sixty and seventy; and 2 were over seventy years of age. There were 2 patients with chronic pancreatitis, 4 with edema of the pancreas, 12 with acute pancreatic necrosis and exudate into the abdominal cavity, and 10 with hemorrhages of the pancreas and other organs of the abdominal cavity, fat necrosis with peritoneal exudate, and partial liquefaction of the pancreas. Of all the patients cured by operation and of those who died of the operation 85.7 per cent and 87.5 per cent, respectively, revealed involvement of the bile passages. Of the 8 cases treated non-surgically about half had a history of gall-bladder colic. In 3 cases, in spite of previous cure of the gall-stone disease, pancreatic necrosis developed later. The method of treatment, the results, the secondary operations, and the late results are discussed in separate groups individually.

(WELCKER). LEO A. JUHNKE, M.D.

## MISCELLANEOUS

**Nobécourt, P.: The Syndrome of Abdominal Pain and Infectious Purpura in a Girl of Thirteen** (Syndrome abdominal douloureux et purpura infectieux chez une fille de 13 ans). *Presse méd.*, Par., 1940, 48: 983.

The author reports a case of a girl aged thirteen years and seven months who entered the hospital because of severe abdominal pains, and was operated upon shortly thereafter with a diagnosis of appendicitis. However, a normal appendix was found. On the following day the patient had to be operated on again because of intraperitoneal hemorrhage, but no source of the bleeding could be found. Soon afterward she developed petechiæ on the abdomen, arms,

legs, and the right eye. Within three days of operation she had her first menstrual period which lasted three days. Within nine days of operation she was well, the petechiæ having faded, and the fever, which had been a prominent feature, having disappeared. Pharyngeal smear showed pneumococci; smear of the conjunctiva showed staphylococci. Bleeding time was fourteen minutes, clotting time six minutes. The red-cell, white-cell, and platelet counts, and the blood smear were normal, the tuberculin test was slightly positive, and the Bordet-Wassermann and the Kahn reactions were negative.

Abdominal pain in connection with purpura has been recognized for a long time. It may occur in the course of an established purpura, the diagnosis then being easy, or as a primary manifestation preceding the appearance of the purpura, in which case the diagnosis is more difficult. There is nothing characteristic about the pain. Vomiting, hematemesis, hematuria, or melena may accompany it. It generally lasts one or two days.

Abdominal pain occurs more frequently in some forms of purpura than in others. It is most common in the form characterized by the triad of petechiæ, arthropathy, and gastro-intestinal disturbances. It is less common in the form of purpura called primary infectious purpura, which is characterized by severe infectious phenomena analogous to septicemia and by a purpuric eruption. It is almost never seen in the Werlhoff-Wichman syndrome, in the afebrile purpura with giant ecchymoses, or in chronic purpura. Gross examination of the peritoneal cavity in the cases with abdominal pain shows congestive lesions on the visceral peritoneum. The author believes that the pathogenesis of this syndrome lies in intestinal spasm as a result of some excitability of the sympathetic nervous system.

Primary infectious purpuras, of which the reported case is an example, are characterized by the abruptness of their onset, the purpura appearing on the second or third day. The eruption is macular with fine vesicles containing clear, purulent, or hemorrhagic fluid in the center of the macules. This usually dries rapidly but sometimes ulcerates. The most common causative organism is the meningococcus, then the pneumococcus, and the disease is usually severe. There is no blood dyscrasia in this form.

Therapy is organized along three lines. Intestinal spasm is combated with heat, liniments, and antispasmodic drugs. The hemorrhages are attacked with such measures as pectin, subcutaneous blood or Witte's peptone, or hepatic extract, prepared according to the method of Whipple and given by mouth. The infection is treated by supportive methods and, if the organism is the meningococcus or pneumococcus, with appropriate sulfanilamide derivatives or antiserum. RICHARD WARREN, M.D.

**Mitchell, G. A. G.: The Spread of Acute Intraperitoneal Effusions.** *Brit. J. Surg.*, 1940, 28: 291.

Fluids escaping within the peritoneal cavity following an acute visceral perforation are guided by a series of natural barriers toward certain potential spaces where they tend to collect. According to accepted teaching, material escaping from a perforated duodenal ulcer passes down to the ileocecal region, along the right external paracolic sulcus. However, careful investigation of a number of such cases coming to early operation showed the presence of stomach contents in the ileocecal region, while the upper part of the right external paracolic sulcus was apparently uncontaminated. Again, it is taught that the stomach contents flow from the right external paracolic gutter into the pelvis, and then into the left infracolic space. In practice, it is observed that the left infracolic space is sometimes contaminated while the pelvis remains unaffected.

Fluid from a perforated duodenal ulcer readily escapes from Morison's pouch into the right subphrenic space, according to common belief. This is refuted by the fact that shoulder pain is not a characteristic early symptom in this condition.

After describing the intraperitoneal barriers or watersheds within the peritoneal cavity, the author describes his experimental methods for determining the spread and localization of intraperitoneal effusions. The method adopted was performed on stillborn infants, preferably fresh. Perforations were made in various hollow viscera through which a cannula was passed. A very fine barium emulsion was slowly injected under a pressure of from 10 to 15 mm. of mercury, one to three hours being required for each experiment. The course of the injection was observed on the roentgenographic screen and frequent x-rays were taken at various intervals of time. As a result of these studies, the writer arrives at the following conclusions:

The supracolic space is subdivided by a simplified terminology into right and left subphrenic and right and left subhepatic spaces.

An accumulation of fluid in the right subhepatic space does not normally escape between the liver, right kidney, and right colic flexure into the right external paracolic groove, but overflows into the right infracolic space through the interval between the liver, gall bladder, transverse colon, and falciform ligament. The right external pericolic groove, really a subdivision of the right infracolic space, is involved later by a spread across the front of the ascending colon, and the fluid then runs upward along this groove and so invades the right subphrenic space.

The pelvis is mainly invaded by a spread of fluid from the infracolic spaces. There is no experimental evidence that the main channel of invasion is along the right external paracolic sulcus. It is shown that the common belief that fluids spread from the pelvis to the left subphrenic space along the left external pericolic groove cannot be verified experimentally because this fluid is arrested by the phrenicocolic ligament. The left subphrenic space is involved by direct spread from the main left infracolic space, and to a lesser extent from the communication which exists between the right and left subhepatic spaces

in the interval between the pyloric end of the stomach, the transverse colon, and the free edge of the falciform ligament. JOHN W. NUZUM, M.D.

**Wilensky, A. O.: General Abdominal Lymphadenopathy, with Special Reference to Non-Specific Mesenteric Adenitis.** *Arch. Surg.*, 1941, 42: 71.

Mesenteric lymphadenopathy is fairly common in children and in young adolescents. It may simulate numerous acute surgical conditions, with abdominal pain of varying severity, fever, and leucocytosis; differentiation is difficult or, frequently, impossible. The attacks subside, as a rule, but recurrences and recrudescences may follow and lead to the clinical picture of a chronic ailment. Although the condition is always secondary, no primary preceding lesion may be demonstrable.

Intra-abdominal lymphadenopathy occurs under several basic conditions: (1) as an accompaniment or integral part of some disease, such as typhoid fever or dysentery; (2) as a secondary manifestation of some intestinal lesion of more or less obscure origin, such as non-specific granuloma; and (3) as a completely understood accompaniment of the so-called "rheumatic group" of diseases usually associated with some strain of streptococci and often preceded by infection of the upper respiratory tract. There is another type of lymphadenopathy which cannot be associated clinically with any demonstrable preceding or accompanying lesion, and is referred to as non-specific mesenteric adenitis. Trauma, allergy, syphilis, tuberculosis, virus infection, toxemia *per se*, and parasites do not bear any causal relationship. No relationship with lymphogranuloma venereum can be demonstrated by the Frei test. The appendix is rarely the portal of entry for the causative agent. The occasional swellings of the mesenteric glands which may be observed following acute appendicitis, are due to abnormal anatomical arrangements. The number of cases in which the bacteria were studied is small, and only about 5 per cent yielded bacterial growth. Various kinds of streptococci predominated.

However, in both segments of the alimentary tract, in the neck and in the abdomen, the lymphadenoid apparatus and the lymph-connecting channels are strikingly alike. Wilensky emphasizes the similarity of physiological, etiological, mechanical, and pathological aspects in disease originating in the oronasopharynx and in that originating in the terminal ileum. The similarity to the ordinarily observed phenomena of cervical adenitis is absolute. In either case local injuries or infections permit passage of the causative agent to the appropriate lymph nodes. It is pointed out that mesenteric adenitis is not an isolated, bizarre, peculiar, or obscure disease, but rather a sequela of other diseases and infections. Accordingly, it may be (1) a local effect of absorption from some local non-demonstrable lesion in the ileal segment (this includes various forms of transient enteritis and other surface infections, various gross and microscopic injuries, and other forms of physical and chemical trauma); or (2) a general response of the entire lymphatic apparatus to a causative agent introduced into a distant and/or regionally connected portal of entry. Commonly, entry seems to be related to "catarrhal" or "throat" infections; less commonly, to a hematogenous mechanism. A third possibility is that of an agent swallowed from the oropharynx and passed along to the terminal ileum, from which local absorption occurs.

Treatment of abdominal lymphadenopathy must be along the lines known to be correct and adequate for the original disease. In the presence of non-specific adenitis and the absence of suppuration or some other complication, conservative treatment would be ideal. However, the present inability to differentiate the condition from surgical emergencies necessitates more or less frequent abdominal exploration in order to establish the true nature of the intra-abdominal condition.

EDWIN J. PULASKI, M.D.

# GYNECOLOGY

## EXTERNAL GENITALIA

**Svetozár, S.: Vesicovaginal Fistulas in Women** (Ueber Harnfisteln bei Frauen). *Bratislav. lek. Listy*, 1940, 20: 65.

The author reports the results of 61 operations for vesicovaginal fistulas in women. The pre-operative preparation in neglected cases must be thorough, and not only the local condition must be considered but also the general condition of the patient. Postpartum fistulas are never operated upon before three months have elapsed after parturition, usually six months after. The knee-elbow position is not recommended particularly, but the Schuchardt incision is employed and frequently bilaterally in order to facilitate exposure. The main condition for success is the close approximation of the edges of the fistula without stretching of the surrounding tissue. Therefore, the neighborhood of the fistula must be prepared meticulously.

In the preparation one must be careful not to injure the peritoneum. This happened to the author several times as the peritoneum is employed to cover the suture line of the fistula. The edges of the fistula are not freshened up. The vaginal wall is separated from the bladder for a distance of ½ cm. surrounding the fistula and the suture is made in three layers. By suturing the muscular layer the hole in the bladder is closed and by the injection into the bladder of from 30 to 50 c.cm. of physiological salt solution the suture line is tested for leakage. Then a second layer of sutures is employed in the muscle layer to reinforce the first layer. The third layer concerns the septum vesicovaginale and with this layer the vagina is closed by a suture which should disturb the tissues as little as possible (Method of Ferguson-Bragnehaye and Fueth). Iodine catgut is employed throughout. A later repair of the perineum is done after healing of the fistula. The author then discusses the various methods of operation reported in the literature (Marchand, Wolkowitsch, Kuestner, Doederlein, Ruebsamen, Martius). The French prefer the transvesical approach.

Fifty-seven cases were due to obstetrical maneuvers and 4 followed gynecological conditions. All of the latter were cured, while of the former 38, or 62.3 per cent were cured; the total cures amounted to 42,or 68.5 per cent. Of 45 vesicovaginal fistulas 40 were operated upon vaginally, 4 abdominally and 1 by a combined operation of 8 vesicocervicovaginal fistulas, 6 were operated upon vaginally, 1 abdominally, and 1 by a combined method. Of 3 vesico-urethrovaginal fistulas 2 were operated upon by the vaginal method and one by the abdominal. One case of vesicovaginal and rectovaginal fistula was repaired vaginally. In 32 of 45 vesicovaginal fistulas the operation was successful and death resulted in 1 case. Of 8 vesicocervicovaginal fistulas, 6 were cured and of 4 vesico-urethrovaginal fistulas 1 was cured; of 3 vesicocervical fistulas 2 were cured; and the vesicovaginal and rectovaginal fistula was cured also. The great number of failures are due to the complicated material at hand. Fourteen patients had previous operations elsewhere without satisfactory results. In 18 the disease was of years' standing. The author does not share the view of Reichenmiller that old fistulas heal poorly; he had many old cases, one of twenty-two years' standing. Seventeen patients did not come back for another attempt. In 9 complicated cases he operated transvesically. Four times he employed the Dittel-Leguen method, 2 times the Trendelenburg method, and twice the combined method. In 1 case after a vaginal attempt the Trendelenburg method was tried but it had to be completed vaginally. Among these 9 operations there were 5 failures, but 2 patients could be healed later by a vaginal operation. There was a total of 19 failures with 1 case of suppurative peritonitis. The source of the infection was a pyonephrosis.

The author discusses in detail the advantages and disadvantages of the after-treatment with residual catheter and postoperative drainage. He leaves the catheter in from ten to fourteen days, administers diuretics, and resorts to careful bladder irrigation at various intervals. In 4 cases infrasymphyseal drainage was employed. Vaginal douches were not employed. The after-treatment lasted twenty-one days. Of the cured patients 12 became pregnant later. Five of the pregnancies ended in abortion and 7 went to term. Four patients delivered spontaneously, and a fistula recurred in 2. Two patients were delivered by abdominal cesarean section and 1 with high forceps.

(Vilma Janisch-Rašković). Leo A. Juhnke, M.D.

## MISCELLANEOUS

**Graff, U.: Endometriosis** (Beitrag zur Kenntnis der Endrometriose). *Arch. f. klin. Chir.*, 1940, 198: 481.

A very detailed review on endometriosis from the surgical standpoint is given, as heretofore only scanty reports on this disease were to be found in the surgical literature, and the knowledge of this peculiar disease may be of great importance in differential diagnosis. The author first tabulates, according to age, 19 cases of resection of the rectum and 23 cases of incomplete partial operation for endometriosis in the rectocervical septum (reported in the literature) and gives the clinical and operative findings, the treatment, and results. This is followed by observations on 75 cases of endometriosis of the sigmoid flexure, including 2 of the author's.

The first case of the author was that of a woman, aged forty, in whom a cecal fistula was made in the

year 1936 for ileus. Later she was again laparotomized for renewed attacks of ileus. Except for a hollow band, which extended from the left ovary to the region of the intestinal stenosis, only a so-called infiltration of the flexure, which appeared to be a carcinoma, was found. Resection was undertaken and the aboral portion of the gut was sutured in as a single-barrelled artificial anus. Recovery followed relaparotomy, which was done ten days after the first intervention. Surprisingly, the operative specimen showed no carcinoma but an infiltration penetrating from without toward the intestinal wall up to the mucosa, in which typical uterine glandular tubes could be demonstrated.

The second case was that of a woman, aged forty-four, who had suffered for a long time with premenstrual symptoms of intestinal stenosis and had to be operated upon for ileus. The cause of the intestinal occlusion was found to be a tumor in the middle of the sigmoid flexure, which macroscopically had to be considered a cancer. At first, only a colostomy was done, but later a resection of the tumor and closure of the artificial anus was followed by recovery. The operative specimen again showed no carcinoma but typical changes in the nature of endometriosis.

There then follows a table of 31 cases of endometriosis of the vermiform appendix and observations upon just as many cases of endometriosis of the small intestine. Among these is included 1 of the author's own cases. It was that of a woman, aged thirty-nine, who complained of premenstrual pains in the hypogastrium for quite a long time. On the assumption of an acute appendicitis an operation was finally done, a typical appendectomy. In the small intestine, 15 cm. above the bauhinian valve, there was found a kinking of the gut, around which from pinhead to lentil-sized, chocolate brown nodules were to be seen. Resection of the diseased portion of the gut was followed by a smooth recovery. With the next menstruation, there was a repeated attack of pain, for which a laparotomy was done at the gynecological clinic. A fist-sized, chocolate cyst on the right side was removed and extensive adhesions in the entire lesser pelvis were revealed. Recovery followed. The examination revealed a chronic appendicitis with oxyuriasis in the lumen of the appendix. There were signs of endometriosis in the small intestine, but none of a neoplasm. The demonstration of glandular tubes in the ovarian tumor was not possible.

Endometriosis in the inguinal region, the umbilical and cicatricial endometriosis, was then taken up for discussion. A case of endometriosis of the abdominal scar following a gynecological operation (probably antefixation of the uterus) from the Frankfort Clinic was discussed briefly. Among the complications of endometriosis, the author's own case of metastatic ovarian abscess following angina is reported and introduced here, as "typical signs of an endometriosis in the pelvic peritoneum" were demonstrable. Microscopically, only abundant granulation tissue with many plasma cells and streptococci was found.

After mentioning the conceptions regarding the genesis of the disease, the author remarks that resection of the stenoses of the small intestine must be designated as the method of choice. In ileus because of endometriosis of the large intestine, at first only emptying of the gut should be done when possible. Then in every individual case it must be decided, whether the intestinal resection should be carried out later, or, especially in older women, whether one must be limited to roentgen castration, which may lead to elimination or shrinkage of the endometriotic foci. In younger women, resection is to be preferred when there is no contraindication to a major surgical intervention. (H. Heidler). Louis Neuwelt, M.D.

# OBSTETRICS

## PREGNANCY AND ITS COMPLICATIONS

**Hunziker, R.: Perforation of the Wall of the Uterus by the Child's Leg During Pregnancy** (Perforation der Uteruswand durch das Bein des Kindes in der Graviditaet). *Zentralbl. f. Gynaek.*, 1940, p. 848.

The patient was a twenty-one-year-old primipara, who had never suffered from abdominal disease. The last menses occurred on the fifth of July, 1938. She entered the hospital as a house case on the first day of April, 1939. Following an entirely uneventful pregnancy, she was sitting quietly at work at a table at five P.M. on April the twelfth, when she suddenly experienced severe pains, radiating out toward the inguinal regions bilaterally. Nausea and vomiting followed. She became pale and her abdomen was tense and painful to pressure; however, the heart-tones of the child were good.

The first thought was of a premature separation of the placenta and a watchful-waiting policy was adopted; the pains became somewhat less acute but the vomiting continued. On the fourteenth of April, thirty-six hours after the onset of the severe pains, labor pains set in, and five hours later spontaneous delivery occurred with presentation of the occiput in the left oblique diameter. However, delivery of the left leg was not successfully accomplished. The girl-child, which was 48 cm. in length and weighed 3,000 gm., cried lustily. In the efforts to free the left leg the uterus was inverted and it was found to be perforated, the limb being firmly held by the uterus at a level above the middle of the thigh. It was held so firmly that a deep furrow around the thigh had resulted with consequent circulatory disturbance in the extremity.

The evidence of hindered circulation in the incarcerated member disappeared in a short while. A laparotomy was done immediately and the uterus was reinverted and extirpated as there was a bloody, dirty-looking fluid in the abdominal cavity, with distention of the bowel and reddening of the peritoneum. Six days after operation the patient died of peritonitis; histological examination of the uterine wall in the region of the perforation did not disclose anything abnormal.

An explanation of the spontaneous rupture of the uterus during pregnancy with extrusion of the leg through the opening cannot be given. The perforation had apparently occurred thirty-six hours before the onset of labor, at the sudden attack of pain.

(Hans Heidler). John W. Brennan, M.D.

**Shute, E., and Barrie, M. M. O.: The Effect of Estrogens on True Pre-Eclampsia and Eclampsia.** *Am. J. Obst. & Gynec.*, 1940, 40: 1003.

As an addition to the records previously reported of the pre-eclamptic and eclamptic women treated with estrogens, the protocols of 7 more pre-eclamptic and 2 convulsive eclamptic patients similarly treated are given. These women were not restricted as regards activity or diet, except for the limitation of sodium chloride in several of them.

Barrie, working in England, has recorded eclampsialike convulsions in certain rats defective in Vitamin E which were suddenly given large doses of d-1-atocopherol. The histological lesions in these animals simulated those of human eclampsia. Shute relates this to the theory that estrogen defect is an important factor in the onset of eclampsia, as Vitamin E is anti-estrogenic in character.

The clinical effects of estrogens on these women are slow in developing, but favorable influences on convulsions, stupor, blood pressure, urinary volume, and albumin have been observed.

Edward L. Cornell, M.D.

## LABOR AND ITS COMPLICATIONS

**Rauramo, M., and Kahanpää, V.: The Principles of Treatment of Apoplexia Uteroplacentaris** (Ueber die Behandlungsprinzipien in Faellen von Apoplexia utero-placentaris). *Acta obst. et gynec. Scand.*, 1940, 20: 243.

There are two main trends in the treatment of premature separation of the placenta: conservative, expectant treatment, aiming at spontaneous delivery; and active treatment, usually by laparotomy. Many obstetricians use both methods, according to the findings in the given case. Rauramo and Kahanpää give a survey of the cases observed in the Women's Hospital in Viipuri, Finland. While from 1919 to 1934 their policy was chiefly conservative, they changed in 1934 to a more active, surgical treatment of uteroplacental apoplexy, and, as the other factors have remained about equal, they feel justified in comparing their results in these two periods.

In these twenty years, they saw 163 cases of uteroplacental apoplexy, in a total of 22,058 deliveries, i.e., an incidence of 0.7 per cent. This is a higher incidence than reported by most authors. They attribute it to a high incidence of toxemia of pregnancy in their territory, to a high percentage of pathological cases among their admissions in general, and to the fact that they counted also minor abruptions. Fifty-three per cent of the 163 women with abruption, i.e., 82 women, had albuminuria, and 34 of them also had eclampsia or eclampsism; 23 per cent had total abruption. Thirty-nine per cent were primiparas; 56 per cent had premature partus. The infant mortality exceeded the percentage which one would consider normal among premature babies.

The authors' "prevalently obstetrically treated" group (1919 to 1933) comprised 94 women, and the "prevalently surgically treated" group (1934 to

1938) 69 women. In the first group, there were only 3 cases of cesarean section (3 per cent); in the second group, there were 33 such cases (48 per cent). In both groups vaginal operation was done in about one-fifth of the cases. Five mothers of the first group and 1 of the second group died. These deaths were attributed to various causes: 2 women obviously died from most severe eclampsia, while the hemorrhage was of not much importance. Two women had severe toxemias, and they, too, probably did not die from the hemorrhage. One patient died chiefly from the hemorrhage, and 1 was admitted moribund; no definite evaluation of the last case was possible. All of the women had not been operated on. Probably none of them could have been saved by more active procedures.

The authors attribute the improvement in their maternal mortality after adoption of more active procedures to the fact that many toxemia cases were operated on immediately after the development of the first signs of abruption. As to infant mortality, 1 child of 26 who were delivered alive by cesarean section and had been mature and not deformed, died. The infant mortality in the "conservative" group was 14 per cent, in the "surgical" group 3 per cent. A comparison of the three methods of treatment used, regardless of the two periods, is given in this table:

| Method of Treatment | Maternal Deaths | Infant Deaths | |
|---|---|---|---|
| Spontaneous delivery, including rupture of the membranes | 2 (2%) | 1 (3%) | Only mature children living on admission are considered |
| Vaginal operations | 4 (12%) | 4 (40%) | |
| Cesarean operation | 0 (0%) | 1 (4%) | |

Both the maternal and infant mortality, in the authors' opinion, suggest that active surgical treatment is preferable as a rule.

In cases of severe and advanced toxemia of pregnancy with abruption of the placenta, the authors advocate conservative treatment, especially because the baby usually is already dead in these cases. In early and light toxemias with a living baby, they prefer abdominal cesarean section. Macroscopically visible uterine hematomas are not an indication for hysterectomy, as they heal well. While toxemia is an important cause of apoplexia uteroplacentaris, it is not the only cause. In the grave cases with a dead child, the authors frequently used dilatation, often followed by version or forceps extraction. Saline and blood transfusions sometimes were used in cases with shock, but as they do not correct the kidney damage, their value is disputable, and at times they may be dangerous.

Early diagnosis is imperative, and it is often possible in patients who are hospitalized because of toxemia. They begin to complain of slight abdominal pain, and suffer from nausea, irritability, pallor (not from anemia but from shock), and labor-like pains; the fetal heart sounds get weaker. The blood pressure falls and there is tenderness of the uterine wall. Vaginal hemorrhage is a comparatively late sign, and so are severe pains, tenderness, marked anemia, and cessation of the fetal heart beat, which is generally mentioned in the textbooks as being significant.

A follow-up study showed that about half of the women with abruption who had answered to questionnaires, had again conceived; the interval between the abruption and the next birth was two and eight-tenths years (compared to an interval of three and three tenths years after normal or premature birth in general). Sixteen of 56 conceptions after abruption terminated in abortion, which coincides with the incidence in cases without abruption. The authors conclude that apoplexia uteroplacentaris does not produce a temporary or lasting sterility, and the incidence of lasting kidney impairment after toxemia with abruption is not higher than after toxemia without abruption. HEINRICH LAMM, M.D.

# GENITO-URINARY SURGERY

## ADRENAL, KIDNEY, AND URETER

**Hamilton, J. E.: Pheochromocytoma of the Adrenal with Paroxysmal Hypertension; A Case Relieved by Surgery.** *Kentucky M. J.*, 1940, 38: 572.

The author presents a case of pheochromocytoma occurring in a thirty-seven-year-old white woman who had the following symptoms: intense throbbing headaches, hot flashes, pounding of the heart, and dyspnea appearing in periodic episodes lasting for several minutes. Ten months before admission the patient became aware of a painless lump in her left upper abdomen, which gradually enlarged to the diameter of about 5 in. This mass caused dragging discomfort, nausea and occasional vomiting, increasing fatigue, dyspnea on exertion, and orthopnea. Examination revealed a well developed white woman with normal secondary characters. Her blood pressure ranged from 160–105 to 140–80. A rounded, slightly tender mass about 12 cm. in diameter could be both seen and felt in the upper quadrant. It was movable and descended slightly upon inspiration. Laboratory findings were essentially negative as were also the gastro-intestinal and pyelographic x-ray studies.

At operation a rounded brownish purple mass 12 cm. in diameter was found pushing through the gastrocolic ligament. The stomach and pancreas lay above it, the spleen to the left, and the colon below. Palpation through a rent in the gastrocolic ligament disclosed that the mass was cystic and that it arose from a broad pedicle in the region of the left kidney. About 250 c.cm. of a thick brownish material resembling old blood was aspirated which partially collapsed the cyst. At this point, because of impending shock, the wound was hastily closed and the collapsed cyst, after first being opened, was stitched into the left angle of the wound.

Eleven months later the patient reported she had had several attacks resembling them but more severe than the ones she had had previous to the operation. She was readmitted to the hospital and found to have repeated hypertensive paroxysms, when she would become flushed and her blood pressure would mount from a basal reading of 130–70 to about 200–120. A tentative diagnosis of pheochromocytoma was made. A second laparotomy was performed and a soft egg-shaped reddish-brown mass approximately 11 cm. in length was found adherent to the site of the previous marsupialization. It extended directly backward through the gastrocolic ligament to the retroperitoneal tissues. The mass was shelled out of its bed, which occupied the position of the left suprarenal gland. No trace could be found of the suprarenal gland. The convalescence was uneventful. Nine months after operation her blood pressure was 155–110.

Gross description of the tumor was an elongated, lobulated spheroid, soft in consistency and dark brown in color.

Microscopic examination showed a lobulated arrangement to the structure and in some sections there were cysts lined by endothelial-like cells. The parenchymal cells were elongated and had eosin-staining granular cytoplasm. JOHN A. LOEF, M.D.

**Swan, R. H. J.: Injuries of the Kidney.** *Brit. J. Urol.*, 1940, 12: 161, 221.

Injuries which involve the kidneys are of the most varied kind, both in the extent of the laceration on the organ and in the severity of the symptoms. It will be convenient to consider them under the following headings:

1. Subparietal injuries in which there is no open wound communicating with the exterior
2. Incised and punctured wounds
3. Gunshot wounds

### SUBPARIETAL INJURIES

These form by far the largest group of cases of renal injuries. They vary from a small contusion accompanied by hematuria to complete rupture of the kidney into two or more parts. Only very rarely are both kidneys injured.

The pathology may be classed as follows:

1. Lacerations of the perinephric fat without any lesion in the renal parenchyma.

2. Subcapsular hemorrhage without visible laceration of the renal cortex.

3. Laceration of the parenchyma of the kidney of varying degrees. There may be small fissures running across one or both surfaces of the organ, usually radiating from the hilum, or deeper lacerations extending into the calyces or into the renal pelvis. More rarely there may be longitudinal fissures along the convex border of the kidney.

4. Rupture of the renal vessels or renal pelvis. Occasionally the vessels may be torn without laceration of the kidney and more rarely the ureter may be detached from the pelvis. In the latter event there may be an increasing effusion of urine in the perirenal area without hematuria.

5. Septic infection is likely to occur in any effusion in which blood and urine are mixed.

6. Associated injuries. There may be present fractured ribs with traumatism to the lung, fracture of the spine, or laceration of other viscera, such as the liver, spleen, or alimentary canal. In some cases the peritoneum may be torn over the perinephric effusion, and allow blood and urine to escape into the general peritoneal cavity, which would produce symptoms of peritoneal irritation and peritonitis.

*Symptoms.* The symptoms of renal injury are briefly: pain in the loin, hematuria, and the formation of a palpable tumor in the renal fossa.

Pain in the side is almost invariably present from the time of the injury, but may be due to trauma of the abdominal wall or to fracture of the lower ribs.

Hematuria occurs in fully 90 per cent of the cases of ruptured kidney. The appearance of blood in the urine may be delayed for several hours or even days after the injury and the amount of blood present is no index of the severity of the traumatism sustained by the kidney.

Formation of a tumor in the loin is a common feature of a lacerated kidney. It consists of an effusion of blood or of blood mixed with urine in the perinephric tissues, but in rare instances in which the renal pelvis or the upper ureter is torn without laceration of the renal tissue or vessels, the leakage of urine into the fatty tissue may cause the swelling.

The quantity of urine passed after an injury to the kidney may vary. In some cases there is a diminished quantity, while in others there may be complete anuria. This is usually a temporary suppression and is followed after a day or two by polyuria.

Later symptoms in a case of ruptured kidney depend greatly upon the severity of the renal laceration, upon the presence of injury to other viscera, and upon the possibility of infection in the kidney or in the effusion in the perirenal tissues.

Septic infection is always likely to occur in any effusion of blood, especially when mixed with urine. The infection may spread upward from the bladder or may arise by hematogenous infection from the blood stream.

*Diagnosis.* The diagnosis of a laceration of the kidney is in most cases relatively easy. The history of a crush injury, followed immediately by pain in the side, collapse, and shock; the palpation of a tumor in the lumbar region; and the presence of blood in the specimen of urine passed after the accident would point to the diagnosis. Hematuria may be delayed, but is present at some time in the great majority of cases. In cases in which hematuria is absent the diagnosis will be made on the nature of the accident, the rigidity of the abdominal muscles on the affected side, the presence of a tumor in the lumbar region, and the amount of shock. In every case, thought must be given to the possibility of severe traumatism to other viscera which may be present in crush injuries. Examination should be made of the chest wall for fracture of one or more ribs, with possibly an intrathoracic lesion, and of the abdomen for increasing rigidity and for free fluid which may lead to a suspicion of rupture of the intestine, liver, or spleen. The spine should be examined for signs of fracture or fracture-dislocation, and the pelvis may undergo fracture with injury to the urethra or bladder which may be the source of the blood in the urine.

*Treatment.* The primary treatment of cases of renal injury consists of rest, warmth, and measures to combat the shock that may be present. The patient should be kept absolutely quiet in bed and morphia should be given freely, partly to maintain complete rest, but also to relieve pain and to quieten the circulation. Strapping the whole side often relieves the pain considerably. A careful watch must be kept upon the pulse rate and the blood pressure, a quickening beat and a progressive fall of blood pressure being indications of increasing hemorrhage. In cases in which no urine is passed after the injury, especially if the desire to micturate becomes increasingly urgent, a catheter should be passed under the most strict aseptic precautions, when it may be found that the bladder is filled with blood-clots. These must be broken up and washed out or removed by means of an evacuating cannula and bottle, as is used after crushing of a vesical calculus. If clots cannot be removed in this way, suprapubic cystotomy may be necessary.

The question of instrumental and roentgenographic examination of the patient may arise in some cases, but it must be acknowledged that many patients are too acutely ill to allow of these and that the evidence obtained by them is too uncertain to be of great value. Cystoscopic examination during the hematuria will show the side of the bleeding and may prove the remaining kidney to be present and functionally active if clear urine can be seen from the other side. Roentgenographic examination will eliminate fractures of the ribs, spine, or pelvis and may show a loss of the normal outer border of the psoas muscle on a plain film if an effusion of blood is present, while pyelographic examination may prove useful in showing the escape of the dye outside of the pelvis and calyces, or distortion of the latter.

Occasionally cystoscopy and ureteric catheterization may be necessary in cases in which the ureter has become blocked by blood clots, which give rise to severe colic. In these cases relief of the obstruction and the pain has been obtained by the drainage with the ureteric catheter.

The indications for immediate operation upon cases of ruptured kidney can be summarized therefore, as follows: increasing or persistent hemorrhage, as evidenced by a steady increase in the pulse rate; progressive anemia and fall of the blood pressure; increasing pain and muscular rigidity over the side of the abdomen and flank, especially its extension to the lowest abdominal quadrant; and increasing size of any palpable tumor in the renal area.

The operation carried out on the kidney must necessarily be, in the first place, an exploration, and it must be left to the judgment of the surgeon to deal with the condition presented to him. It should be the constant aim of the surgeon to preserve the kidney if there is any chance of saving the organ, and it has been shown that functional recovery of the renal tissues is possible after the repair of lacerations at the expense of cicatrization in the area of injury. In many cases a laceration of the cortical area, even implicating the calyces, may be closed by mattress sutures, preferably with ribbon catgut, as suggested by Lowsley, or a piece of muscle or fat may be incorporated in the line of suture to add additional strength; while in other cases firm packs of gauze may be used and left *in situ* for some days.

In some cases in which the kidney has been lacerated, operation may become necessary at a later stage. Bleeding may recur after a varying interval and there is always the possibility when urine has been extravasated into the perinephric hematoma that infection may occur.

By adding three groups of cases published by Young, Riese, and Sutter together, it will be found that in 1,232 cases treated wholly by expectant methods 264 or 21.4 per cent of the patients died. Two hundred and twenty-eight patients were operated upon without removal of the kidney and of these 31 (13.6 per cent) died. Of 209 patients on whom nephrectomy was performed, 36 or 17.6 per cent died. Open wounds of the kidney are less frequent than the lacerations produced by violence and include those received from stabs of a dagger, bayonet, forks, falls upon spiked railings, as well as those received in warfare from bullets, shrapnel, or shell fragments. The anatomical position of the kidney, deep in the loin, makes it improbable that any object penetrating to the kidney should not injure other organs in addition to the kidney.

Wounds received from knives and daggers may enter from the back, from the side, or from the front, and the line taken by the implement may give some guide as to whether other organs are likely to be injured, those most frequently involved being the pleura, liver, and intestines. There is usually bleeding from the wound and hematuria occurs, though this may be delayed for some hours.

If the injury involves the calyces or the renal pelvis, the blood escaping from the wound will be mixed with urine, though the latter may not appear for some time after the accident because of temporary inhibition of excretion. There is usually pain in the side with some fixation of the abdominal muscles on the injured side, but in contradistinction to the subcutaneous injuries, there is seldom any perinephric effusion of blood or urine owing to the escape of the latter through the parietal incision and in consequence there is no palpable tumor in the loin. In cases in which the renal vessels are divided, the hemorrhage may be severe and rapidly fatal. In less severe cases the bleeding from the external wound gradually diminishes, whereas the amount of urine in the discharge increases.

Septic infection is particularly likely to arise in these cases, usually about the fourth day after the injury, and give rise to pyrexia, increased pain, and the appearance of a purulent discharge from the wound.

The treatment of these cases should be directed in the first instance to the arrest of hemorrhage and the thorough cleansing of the wound. The edges of the wound and as much as possible of the track should be excised, and if the bleeding is only slight the area may be lightly packed with vaseline gauze or with gauze soaked with flavine paraffin. In cases in which the bleeding is persistent the wound should be fully opened and the kidney exposed. Every effort should be made to preserve the organ, any laceration being closed by including pieces of fat or muscle under the sutures.

### GUNSHOT WOUNDS OF THE KIDNEY

Gunshot wounds of the kidney are usually seen during warfare, but occasionally they may occur in civil life. They may be caused by rifle, machine-gun or revolver bullets, by shrapnel balls, or more frequently by fragments of shell or bomb casing. A bullet may perforate the kidney and cause comparatively little damage unless the major calyces of renal pelvis are injured, in which case there is an escape of urine into the perinephric tissues and a pronounced risk of subsequent infection. The lesion caused by a shell or bomb fragment is usually more severe because of the shape and roughened surface of the missile, the rotary motion of the fragment, and the fact that the missile is particularly liable to carry in with it pieces of clothing and equipment, which may seriously infect the damaged area.

The damage to the kidney by gunshot wounds varies within wide limits. The organ may be merely contused by the passage of a bullet in close proximity, which causes a subcapsular laceration similar to that seen in non-penetrating wounds. It may be perforated by the missile, sometimes bisected in transverse wounds, while in other cases the renal tissue may be severely pulped.

Coincident injury to the liver, spleen, stomach, and intestines is not uncommon and experience during the last war demonstrated that cases in which the colon was lacerated gave a worse prognosis than those in which other visceral injury complicated the picture. Besides injury to the abdominal viscera as a complication of renal injuries, it is by no means uncommon to find a perforation of the lower thorax, with effusion of blood into the pleura.

*Diagnosis.* It will be seen that the diagnosis of gunshot injury to the kidney does not as a rule present much difficulty. The position and the direction of the wound, the pain and perirenal effusion followed by hematuria, and the escape of blood-stained urine from the wound make the diagnosis plain. Localization of the fragment by shift films or by stereoscopic films may be necessary and, in a few cases in which there is no immediate urgency, it may be advantageous to obtain more accurate localization of a fragment or bullet by means of a radiopaque catheter passed up the ureter after cystoscopy. Of equal importance to the diagnosis of renal injury is the necessity to form an opinion as to whether other viscera have sustained injury at the same time, so that if operation is contemplated, an incision can be planned to treat both organs.

*Treatment.* The preliminary treatment of any patient suspected of having an injury to the kidney should be directed against shock. He should be maintained at complete rest, given morphia in full doses to allay his pain and anxiety, and have warmth applied by means of radiant heat cradles or electric blankets if current is available. If it is thought that no other organ than the kidney has been wounded,

the surgeon should not hasten operation unless there is evidence of progressive bleeding, of infection, or of peritoneal irritation. When the injury is caused by a shell fragment or by a bomb and the missile remains in the tissues, as shown by an x-ray examination, there is strong probability of infection following from pieces of clothing or dirt introduced into the wound. The area around the entrance wound and the track made by the fragment should be freely excised, the missile removed, and the laceration of the kidney should receive treatment. The treatment given to the kidney will depend upon the nature of the lesion displayed. If the wound does not involve the renal vessels and the amount of laceration is not too severe, every effort should be made to preserve the organ, the lacerations being closed by mattress sutures of ribbon catgut and reinforced if necessary by pieces of fat or muscle enclosed in the sutures. In perforating wounds caused most frequently by rifle or machine-gun bullets and in which it is thought probable that other viscera have been injured, the immediate necessity will be to treat these organs and to treat the renal wound from the same incision rather than to close the abdominal wound and then to make a separate opening in the loin, because of the rapid fall of the blood pressure which may result from the movement.

Perforating wounds of the lower thorax involving the kidney may be very difficult to differentiate from intra-abdominal lesions. Considerable rigidity of the abdominal wall may be present without any peritoneal injury; in the absence of signs of continued bleeding these cases may be carefully watched, but in large open wounds of the chest, operation will be necessary. A laceration of the upper pole of the kidney can be sutured through a rent in the diaphragm which can afterward be sewed up.

*Results.* Gunshot wounds of the kidney must be regarded as of serious import and as carrying a heavy mortality, and it has been pointed out that statistical figures gained from forward and base hospitals during wartime are probably inexact, as many patients probably succumb before reaching the hospital. In cases in which other viscera are injured the death rate is higher and it would appear that coincident injuries to the colon are the most serious. The association of a lower thoracic injury with a wound of the kidney does not carry as grave a prognosis as a case in which a hollow viscus is lacerated.

JOHN A. LOEF, M.D.

**Hareide, I.: Roentgenography in Renal Injuries, with Special Consideration of Intravenous Urography** (Ueber die Roentgenuntersuchung bei Nierenverletzungen unter besonderer Beruecksichtigung der intravenoesen Urographie). *Acta radiol.*, 1940, 21: 292.

In the examination of patients with trauma in the renal region several questions of great importance in the treatment arise. Is there an injury of the kidney? Of what nature and extent is the renal injury? In the case of a nephrectomy is the uninjured kidney able to take over the renal function? Are there any complicating lesions, especially in the intra-abdominal organs? Next to the clinical examination, roentgenography is of decisive importance, especially urography. The usual clinical examination generally gives more or less definite information as to the presence of a renal injury, but the diagnosis may be difficult in the absence of the most important symptom, hematuria, especially in the presence of rupture of the renal artery or of the ureter or in the presence of occlusion of the ureter by a coagulum.

After the diagnosis has been made, it is very important to establish the anatomical details of the renal injury, as the nature and extent of the anatomical changes are decisive in the treatment. Clinically, the extent of the hemorrhage may be judged by the palpable hematoma and the general symptoms of internal hemorrhage. Aside from the fact that the symptoms of an acute anemia may, for example, be due to the complicating rupture of an intraperitoneal organ, and that the palpable mass may be due to urinary infiltration, hemorrhage is only one of the factors that is decisive in the selection of the treatment. Even when the hemorrhage is not serious to life, the renal injury may be of such a nature that a nephrectomy or a conservative operation is indicated, as in the presence of a more or less severe injury of the renal pelvis. When the renal injury is severe enough to require nephrectomy the condition of the other kidney may contraindicate the operation. Even though congenital renal hypoplasia and aplasia are not common they are found often enough to require consideration in practice. Intravenous urography is the surest and easiest method of determining the condition of the uninjured kidney.

The diagnosis of possible intra-abdominal complications, e.g., rupture of the liver, spleen, or intestine, requires the knowledge of the examination technique for and roentgenological symptoms of exudate, blood, and free air in the peritoneal cavity. In the examination of injuries from dull force, urography may be retrograde and intravenous. Although retrograde pyelography has given good results, it has certain deficiencies that disbar it from use as a routine examination of recent renal injuries, as in the presence of marked hematuria or a poor general condition; the method also fails in children and harbors the possibility of infection. Intravenous urography has the advantages of simplicity of execution and absence of infection.

The author reports on 16 patients in whom hematuria appeared after a trauma in the renal area, either as a single symptom or associated with more or less typical local and general symptoms of a renal injury. The examinations were made within from a few hours to three days after the injury. The importance of the earliest possible examination after the injury is shown by several cases, inasmuch as characteristic changes in the urogram, which are distinctly evident in the first examination, might disappear in a few days.

Fig. 1

Fig. 2

The injuries may be of all possible grades, from slight crushing to complete destruction of the renal parenchyma or rupture of the renal pedicle. Kuester classifies them as follows: (1) rupture of the fatty capsule; (2) rent in the renal substance, not reaching the renal pelvis; (3) rents which penetrate the renal pelvis; (4) crushing of the kidney into a bloody mass; and (5) rupture at the hilus with integrity of the renal substance. Another group, not included in this classification, is subcapsular injuries, which produce a swelling of greater or lesser portions of the kidney and, since a perirenal infiltration worthy of mention is absent, it is recognizable by an enlargement of the renal shadow.

The findings of plain and intravenous roentgenography are discussed. With plain roentgenography the abdomen may appear perfectly normal when the injury is subcapsular and there is no infiltration of blood present, in which case the renal outline is clearly shown. However, even under these conditions an enlargement of the kidney may be due to a renal injury. The most characteristic and constant sign is the perirenal hematoma, recognizable by a blurring of the renal and psoas contour, which is more or less pronounced according to the amount of the hemorrhage, or, when the hemorrhage is more marked, causes a diffuse shadow in the renal area, which may reach below the iliac crest in extreme cases (Fig. 1). In most cases of perirenal infiltration of blood there is a scoliosis of the lumbar vertebræ. There may also be diminished movements of the diaphragm and, possibly, fluid in the pleura. Colonic meteorism is a frequent symptom in renal rupture, especially with large retroperitoneal hemorrhages. The general picture is like that of perinephritis, with the difference that as a result of an inflammatory infiltration toward the flank, the subperitoneal fatty strip is indistinct, with both retroperitoneal and intraperitoneal processes.

The most constant intravenous urographic finding is deformity or filling defect of the renal pelvis, which was observed in 11 of the 16 patients. It occurs both with and without hematoma. One or more calyces may be missing, contracted, or of irregular outline, or the outline may be distinct and the central portions show a large filling defect. These changes in outline may be due to coagula filling the renal pelvis or to pressure from blood and edema in the renal parenchyma or perirenal tissue and, finally, to rupture into the renal pelvis. Dilatations are due to coagula causing obstruction in the ureter. Another important symptom is the medial displacement of the upper portion of the ureter and the displacement of the junction of the ureter and renal pelvis upward and medially. If the rupture passes through the wall of the renal pelvis the presence of contrast medium outside of the renal pelvis is particularly characteristic of renal rupture. The differentiation between ruptures affecting the "terminal calyces" and those situated more distally is important because the first should be treated conservatively, whereas the second require operation. Only the latter lead to perirenal urinary infiltration. It is, therefore, important to determine whether the contrast medium seen outside of the renal pelvis lies in the renal parenchyma or perirenally. Even ruptures with marked urinary infiltration of the renal parenchyma may heal spontaneously, and perirenal urinary infiltration may recede spontaneously, but this should not be relied upon.

The function of the injured kidney may be normal, diminished, or completely absent. One weakness of intravenous urography is that excretion of the contrast medium is so deficient that the changes in the renal pelvis are not distinct; experimental observations have also shown diminished function of the injured kidney. In actual practice this objection is not so significant as in the majority of cases the excretion of contrast medium is sufficient and the information that the renal function is impaired is valuable. Weaker contrast of the injured renal pelvis than contrast of the healthy kidney is not always significant of diminished function, as other factors may be involved, e.g., the greater or lesser ability of the renal pelvis to empty its contents; also, coagula may give the impression of diminished excretion of contrast medium (Fig. 2). If the patient's condition permits, compression over the ureter should be employed in order to secure good filling. The examination should not be completed too soon, especially when rupture of the renal pelvis or diminution of renal function is suspected. In isolated cases absolutely no excretion of contrast medium is seen, which indicates a severe injury requiring nephrectomy.

Some authors ascribe the diminution of renal function to shock, while others deny this. Opinions are also divided regarding the condition of reflex anuria. The renal function may also be impaired by disease present before the injury.

Experimentally it has been shown that after a trauma the kidney retains its function according to the degree that functioning renal tissue is present and the circulation is maintained. The renal function seems to depend upon three factors: (1) the renal parenchyma, (2) the circulation, and (3) the patency of the ureter. This explains why, even with slight injuries, excretion of contrast medium may be entirely absent. In case no contrast medium is seen in the renal pelvis in the first examination while normal conditions or only slight changes are visible in the control examination, blockage of the ureter is probably the cause. LOUIS NEUWELT, M.D.

**Hammarsten, G. Kidney Stones and Their Analysis** (Ueber Harnsteine und ihre Analyse). *Nord. Med.*, 1940, p. 1329.

The population of Sweden is fed mostly on meat and cereals, whereas fruits and vegetables are diminished in the ration allowance. This naturally exerts an influence on the composition of the urine and the calculi formed in the urinary passages. The uric acid and phosphate stones are decreased while the oxalate and oxalate-phosphate stones are increased. The physicochemical analysis of 594 stones of the urinary tract which were removed from inhabitants of south and west Sweden and examined at the Medico-Chemical Institute at Lund revealed pure calcium-oxalate stones in 28 per cent of the cases, calcium-oxalate and earthy alkaline-phosphate stones in 24 per cent of the cases, and calcium-oxalate and uric-acid stones in only 4 per cent of the cases. Altogether these stones constituted 56 per cent of the entire number. In addition, calcium-oxalate formed a constituent of the nucleus of 7 per cent of other calculi which contained ammonium-magnesium-phosphate.

The figures indicate the predominant rôle of calcium-oxalate in the formation of urinary calculi in Sweden. Many ammonium-urate stones are considered primary in origin, and only 35 per cent of the entire number were the result of infection of the urinary tract.

For the study and investigation of stones the author presents and suggests a precise outline and the necessary chemical reagents.

(R. GUTZEIT). JACOB E. KLEIN, M.D.

## BLADDER, URETHRA, AND PENIS

**Carson, W. J.: Tumors of the Penis.** *J. Urol.*, 1940, 44: 307.

The author presents a short résumé of the literature on tumors of the penis and adds the case reports of 4 penile carcinomas. From a clinical and histological study of the cases observed, he concludes that the large number of lymphatics and their anatomical arrangement make the treatment of carcinoma of the penis analogous to cancer of the breast. The literature shows that the longest cures in each of these types of carcinoma are secured by radical surgical removal of the tumor mass with the surrounding lymphatics.

When the tumor has extended to the bulb, transplantation of the membranous urethra into the perineum is indicated. Since all palpable inguinal lymph nodes show infection, while approximately 50 per cent show metastasis, enlarged lymph nodes do not contraindicate surgery. D. E. MURRAY, M.D.

# SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

## CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Paul, L. W., and Pohle, E. A.: Solitary Myeloma of Bone; A Review of the Roentgenological Features, with a Report of 4 Additional Cases.** *Radiology*, 1940, 35: 651.

The authors review a series of 45 cases of solitary myeloma of bone as recorded in the literature and report 4 additional new cases. Particular reference is made to the roentgenological features.

Although the study was conducted primarily from the roentgenological point of view, certain features in the clinical picture were considered worthy of note. There were 35 males and 10 females. Except for 1 infant nineteen months old, the age varied from twenty-nine to seventy-one years, the average being 48 years. More cases (16) occurred in the fifth decade. The thoracic spine (9 cases), pelvis (10 cases), and the femur (8 cases) were the most frequent sites of involvement. In 3 instances the lesion was found in the skull, in 5 in the humerus, in 3 in the cervical spine, in 2 in the lumbar spine and jaws, and single cases occurred in the clavicle, tibia, and sternum, respectively. In the pelvis, the ilium was the most frequent site of the tumor and in the femur the proximal part was involved in all 8 cases of this group. The duration of symptoms before the first observation varied from a few weeks to four years. The total period of observation varied from a few days to twelve years. In those patients in whom the disease became generalized, the time from the first observation to the onset of generalization varied from two months to three years.

Roentgenologically speaking, two main types of lesion occur. The first is characterized by an osteolytic, multicystic-appearing area of rarefaction somewhat simulating giant-cell tumor. The lesion usually is sharply demarcated and centrally located in the medulla when occurring in a long bone, and it may or may not expand the bone. The area of destruction is crossed by irregular and sometimes rather thick trabeculæ. In some of the cases destruction of areas of the cortex was found but more commonly the cortex was intact. No periosteal reaction was produced. Pathological fracture was frequent. This multicystic type of tumor was often mistaken for giant-cell tumor.

The second type of lesion seen was a purely destructive one. This, too, was commonly located in the medulla and when in long bones, tended to extend up and down the shaft. The margins were sharply demarcated and expansion was present occasionally. The essential differences between this type of lesion and the cystic form in long bones were the absence of trabeculations and a decreased tendency toward expansion. This osteolytic type was the one commonly encountered in the spine; it often began in one body and later extended to adjacent bodies and appeared to cross the intervertebral discs. No proliferative bone changes were described.

The plasma-cell type of myeloma predominated, there being 41 cases of this form.

Treatment varied according to the size and location of the lesion. Surgery varied from biopsy and curettage to partial removal of the growth, complete resection, amputation, or disarticulation. Surgery was usually followed by roentgen therapy, and it was believed that biopsy followed by extensive roentgen therapy offered the best chance of prolonging life. The authors used fractional doses of 200 roentgens at daily intervals until a total dose of from 1,200 to 1,600 roentgens per field had been given. This was repeated if deemed necessary at a later date. In cases with generalized involvement so-called "general body exposure" was administered with good response in some.

Five of the authors' own cases are reviewed in detail, all of which originated as solitary lesions. The patients in 2 of these had multiple lesions at death and another patient showed spreading of the original lesion when last seen. The author's last 2 cases, however, had shown no tendency to spread when last seen, although neither had been followed up more than a year. F. HAROLD DOWNING, M.D.

**Phemister, D. B.: Changes in Bones and Joints Resulting from Interruption of the Circulation. Non-Traumatic Lesions in Adults with Bone Infarction; Arthritis Deformans.** *Arch. Surg.*, 1940, 41: 1455.

The author reports additional cases of infarction and of secondary arthritis deformans due to blockage of the circulation in bones of adults, which indicates that the lesion is not uncommon.

Arteriosclerosis of the vessels of the extremities which results in a marked degree of impairment of the circulation or in gangrene has received scant consideration as a possible cause of infarction of bone. Routine roentgen examination and section of all of the bones of the extremities amputated because of arteriosclerotic gangrene should be made for the purpose of establishing the frequency of such circulatory disturbances. Arteriosclerosis was a probable cause in one of the reported cases although direct proof is lacking.

Caisson disease was the established cause in another of the reported cases and the nature of the osseous and articular pathological processes in caisson disease was verified in 1 of the previously reported cases by studies of the head of the femur subsequently removed at operation.

That hypertrophic arthritis and bone infarction may in some cases be due to a common cause is suggested by their long association in 2 cases presented. The cause of chronic hypertrophic arthritis is still

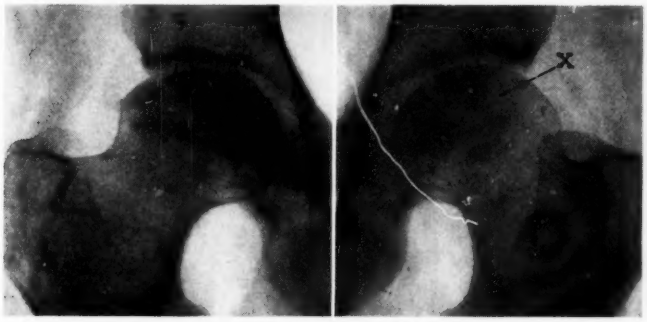



Fig. 1. Aseptic necrosis in the head of the femurs, with a depressed sequestrum at weight-bearing portion of the right head (y) and absorption of bone in the left head (x). Dull pain had been present in the right hip for eight months. No symptoms were present in the left hip.

very much in the dark. Pommer considered the primary change to be a degeneration of the articular cartilage resulting from nutritional disturbance and the subsequent changes in both cartilage and bone ends to be due to weight-bearing and movement. In some cases the nutritional disturbance is assumed to arise from the trauma of ordinary use in aging or senile cartilage. In other cases changes in the underlying bone are known to precede changes in the cartilage. These are well illustrated in the cases reported here. This raises the question whether in other cases there are primary changes in the vessels of the subchondral bone, due to other causes, which result in nutritional interference and degeneration of the cartilage with subsequent hypertrophic arthritis, since most nutrition of the cartilage comes from the underlying bone. The subchondral fibroplasia in the marrow spaces, bone sclerosis, and formation of cavities filled with fibrous tissue or fluid which are present in some cases are rarely associated with arteriosclerosis or with obliterative endarteritis of the vessels in the involved region.

The following case of bilateral involvement is of special interest in that on one side the head broke down and in six years went through the usual changes, ending with deforming arthritis, while on the other side it retained its form, the necrotic area undergoing reconstruction without the development of arthritis. In this case the indications are that on the right side the necrotic areas within the head included the entire upper portion and that absorptive changes within it so undermined and weakened the weight-bearing portion that it caved in. On the other hand, the central area of necrosis of the left head neither involved the superior portion nor so weakened it that collapse resulted. Consequently, with reorganization of the necrotic area the bone was restored practically to normal, and in the absence of extension of the process to the surface with necrosis of articular cartilage, arthritis deformans was not a sequel.

One feature of this case, namely, the roentgen evidence of extensive absorption in the necrotic field of each head of the femur, suggests that some factor

Fig. 2. Progression of the lesions two and one-half years after Figure 1 was taken. The right hip was continuously painful and stiff. The left hip had lately been slightly painful on extensive use.

Fig. 3. Roentgenograms taken twenty-six months after Figure 2. The left hip was symptom-free and the density of the head restored almost to normal. The right hip was still painful and restricted in motion. The necrotic area (y) was mottled from creeping replacement by new bone.

other than simple blockage of the circulation to the bone may have been active. The area of reduced density in the head of the left femur was not unlike that produced by the fibrous and cystic areas seen beneath the articular cortex of either the head or the acetabulum in cases of chronic hypertrophic arthritis, which again suggests an etiological relation with that condition.

There are two ways in which the usual type of osteochondritis dissecans differs from the formation of loose bodies associated with massive necrosis and consisting of articular cartilage and bone detached from the articular surface. In the first place, the surrounding bone nearly always appears normal in the roentgenograms, which indicates that all of the bone which became necrotic had been detached, whereas in the case of massive necrosis of bone bordering on the joints, the weight-bearing portion becomes detached while the relatively large remaining necrotic portion undergoes creeping substitution by atypical new bone which is demonstrable in roentgenograms. In the second place, the loose body in a case of osteochondritis dissecans much less frequently becomes reattached in its bed and invaded and replaced by new bone than does the loose body formed in the presence of massive necrosis of bone bordering on joints. A case of necrosis of the lunate bone is presented.

There are numerous roentgenograms, photomicrographs, and reproductions of gross specimens, some of which are sectioned and roentgenographed, accompanying the article. ROBERT P. MONTGOMERY, M.D.

**Davis, J. B.: Recurrence of Infection After Elective Operations in Cases of Healed Suppuration in Bone and Joints.** *Arch. Surg.*, 1940, 41: 1426.

Operative trauma, such as that associated with arthrodesis, arthoplasty, or osteotomy, differs only slightly from closed external trauma. One should, therefore, expect some recurrence of infection in healed suppurative lesions of bones and joints in the event of operation. The complication of recurrence is a major affair and should be avoided whenever possible. The length of time that the infectious process has been quiescent has no relation to the recurrence of infection. A total of 215 operations on healed suppurative areas in bones and joints from the service of Arthur Steindler is the basis for this report.

*Operations for gonorrheal arthritis.* All of the operations were done directly into the old healed articular areas, and all included work on bone; yet, in spite of this and the fact that in some instances the areas had been healed for only six months, there were no recurrences of infection. Gonorrheal arthritis, once it is healed, does not recur after operative trauma. Subsidence of the acute infection and return to the normal afebrile state for a period of six months should be a sufficient interval.

*Operations for suppurative arthritis.* Pure suppurative arthritis, when healed, recurs in only 13 per cent of cases when operation is performed through the previously involved area. The recurrent bacterium was the staphylococcus in 5 cases and the streptococcus in 1 of a total of 48 cases. Operations done near but not through the area of suppurative arthritis showed an 8 per cent frequency recurrence of the infection and a much shorter period of secondary healing.

*Operations for hematogenous osteomyelitis.* The recurrences were preponderantly staphylococcic and amounted to 46 per cent when the operation was performed through the previously involved area and to 2.5 per cent when done in close proximity to it but not through the previously involved bone. By careful analysis of the roentgen appearance of healed osteomyelitis it is possible to anticipate which infections will recur in the event of surgical intervention. The use of a magnifying lens to disclose sequestra that would not be observed on a less detailed search is emphasized.

The presence of sequestra in the operative field is indicative of recurrent infection. Recurrence was found in all of the 5 cases that were operated upon.

Abnormal trabeculations and sclerosis must be considered as a danger sign. When normal trabeculations and density have reformed in the absence of sequestra, indicating a healed osteomyelitic process, operations can be performed without danger of recurrence.

*Operations for traumatic osteomyelitis.* Secondary recurrent complications occurred in 28 per cent of the cases. The time of quiescence is not related to the recurrence. A six-month quiescent period is recommended by Watson-Jones before operation.

ROBERT P. MONTGOMERY, M.D.

**Krogdahl, T., and Torgersen, O.: "Uncovertebral Joints" and "Arthrosis Deformans Uncovertebralis;" a Pathologico-Anatomical and Roentgenological Study** (Die "Unco-Vertebralgelenke" und die "Arthrosis Deformans Unco-Vertebralis." Eine pathologisch-anatomische und roentgenologische Studie). *Acta radiol.*, 1940, 21: 231.

Deforming spondylosis is characterized pathologico-anatomically by degenerative processes in the annulus fibrosus of the intervertebral discs as well as by reactive bone changes in the adjacent vertebral bodies with the formation of exostoses and subchondral sclerosis. The formation of exostoses is the predominant feature.

As the result of degenerative processes with cleft formations in the annulus fibrosus, especially in the peripheral parts of the latter, the expansive pressure of the nucleus pulposus exerts traction upon the longitudinal band in such a way that this, corresponding with the intervertebral disc and the adjacent marginal ridge, protrudes itself rigidly. When the vertebræ move against each other the disc is subjected to abnormal tuggings from the anterior longitudinal ligament. Reactive osseous changes in the form of exostoses are produced at its sites of insertion on the vertebral bodies.

While the roentgenological signs of the deforming spondylosis in the thoracic and lumbar portions of the spine fully correspond with the explanation of the localization of the exostoses, this does not seem to be the case with the cervical portion of the spine. Lateral exposures of the cervical portion of the spine also quite often show exostoses, which are chiefly localized posteriorly on the borders of the vertebral bodies and seem to penetrate into the spinal canal. Inasmuch as the anterior longitudinal ligament is considerably narrower in the cervical portion in comparison with the size of the vertebral bodies and the other portions of the spine, the exostoses must have another pathogenesis than the usual exostoses in deforming spondylosis. A priori, the exostoses cannot even be considered as the expression of a deforming spondylosis in the true sense, as they show no relation to the anterior longitudinal ligament. This frequent finding of so-called posterior exostoses in cervical spondylosis induced the authors to investigate the nature, localization, and significance of these exostoses, and also to offer an explanation of the normal anatomy and roentgenology.

Fig. 1

The first effort was to determine whether the so-called "hemiarthroses" or "uncovertebral joints" are really normal anatomical formations or whether they should be considered as pathological phenomena. It was found that cleft formations occur normally in the lateral portions of the intervertebral discs in the cervical portion of the spine, and also that this cleft is circumscribed by a fibrous, capsule-like membrane. These cleft formations are to be strictly differentiated from the more medially located, irregular, and inconstant cleft formations, which are considered to be artefacts, especially when no signs of a degenerative process or other pathological changes in the intervertebral discs are visible. The justification for the designation of these connections as "joints" may be questioned because some of the characteristics of true joints are missing, but the term "uncovertebral joints" is retained because it has been generally accepted and because it, nevertheless, gives the best idea of the anatomical conditions.

In the frontal picture, the uncinate process appears distinctly laterally on both sides of the upper border of the vertebral body from the first thoracic to the third cervical vertebra, inclusive. The intervertebral cleft bends upward at the base of the process and simultaneously becomes narrower. The uncinate process stands out boldly both outward and against the roentgenological cartilaginous cleft, with a smooth contour without dentations or irregularities. It is important to observe that the outer border of the uncinate process normally lies more laterally than the border of the next higher vertebral body. The extent of the cartilage in the uncovertebral joint may normally vary considerably, but usually it amounts to a third or half of the height of the corresponding intervertebral disc. The cartilaginous cleft appears in the roentgenogram as almost wedge-shaped, being broader medially than laterally.

In the lateral picture, it is seen that somewhat more than the posterior half of the clearing of the affected disc is covered by both of the uncinate processes, and that the posterior border of the prominence usually reaches somewhat more posteriorly than the rest of the vertebra. It is also seen that the marginal ridge does not course along the edge of the uncinate process, but along its base. This behavior indicates that the uncinate process must be considered as belonging to the transverse process,

and the roentgenological observation also supports the theory that the uncinate process is a counterpart of the head of the rib in the thoracic portion.

Oblique projections show, in agreement with the anatomical conditions, that the medial anterior limitation of the intervertebral foramina are not formed, as in the other parts of the spine, by the intervertebral discs and the adjacent portions of the vertebræ, but by the uncinate process and the borders of the uncovertebral joint. The foramina are considerably larger than in the thoracic vertebræ with a diameter of about 10 mm. Their form is usually oval (or nearly quadrangular with rounded angles) with the longest axis placed vertically. The lower half is usually somewhat smaller than the upper. The border is smooth, without marked projections. The posterior lower portions of the intervertebral disc of the opposite side may be projected anteriorly into the foramen and there simulate exostoses. The lighter shadow of the vertebral arch is projected into the foramina to a greater or lesser extent.

The pathologico-anatomical findings are summarized as follows:

The uncovertebral joints very often form the site of deforming processes with the formation of exostoses. When these are localized in the posterior portion of the joint, they may produce a constriction of the intervertebral foramen. If the exostoses are situated somewhat more anteriorly, the vertebral canal with its contents may be affected.

The roentgenological signs of arthrosis deformans in the uncovertebral joints are on the whole similar to those of arthrosis deformans in general. A frontal exposure offers a good view of the changes, and shows that the extent of the cartilage is diminished and that the signs of subchondral sclerosis vary to some extent. It is often striking that the upper part of the uncinate process appears evenly flattened, which gives the cartilaginous cleft a more transverse course. The most important sign is the formation of exostoses. In the frontal picture these are circumferential, and usually most markedly so at the upper border of the joint. These upper exostoses often have the typical beak or claw shape as they project over the uncinate process. However, even with relatively slight changes, the exostoses not rarely cause the upper joint border to appear as reaching more laterally than normal. The authors believe that this finding in the more doubtful cases deserves diagnostic importance. In the lateral exposure the exostoses are visible posteriorly, according to their position against the most posterior part of the intervertebral foramen and the adjacent portion of the spinal canal. The posterior projection assists in determining the influence of the exostoses upon the intervertebral foramina. The important relation of the uncovertebral joint to the vertebral artery and nerve cannot be demonstrated roentgenologically. The exostoses on the more anterior portions of the joint are best reproduced in the frontal exposure, partly also in the oblique exposure, whereas in the lateral exposure they are not projected clearly. If in such cases the exostoses are not very small, it may be concluded that the vertebral canal is constricted. Conversely, exostoses which are localized around the posterior portions of the joint are circumscribing in the lateral exposure posteriorly and in the oblique exposure against the intervertebral foramen, whereas in the frontal exposure they are not visible at all or only barely perceptible. If circumscribing exostoses are seen in all three projections, it may be concluded that they are localized around the entire circumference of the joint edges. These changes are found most often in association with a spondylosis deformans, but may appear also in one or several uncovertebral joints without simultaneous signs of anything else being definitely abnormal.

The authors believe that the deforming process in the uncovertebral joints is the causative agent responsible for Barre's "posterior cervical sympathetic syndrome." LOUIS NEUWELT, M.D.

**Henschen, C.: Meniscus Lipoma as the Indirect Cause of an Attrition Meniscopathy Leading to Spontaneous Rupture. Monographic Study concerning Tumors of the Semilunar Cartilage of the Knee** (Menisculipom als indirekte Ursache einer zur Spontanruptur fuehrenden Abneutzungsmeniskopathie. Monographische Studie ueber die Geschwulste der Menisken). *Zentralbl. f. Chir.*, 1940, p. 1762.

Tumor formations of the semilunar cartilages of the knee joint have until now been rarely observed. Evidently the tissue of the semilunar disc, which has been designated by the anatomist as cartilaginous tendon, forms a poor soil for the development of tumors. Aside from this, any tumor which might arise would be destroyed in its incipiency by the mechanical forces acting upon the meniscus just as if the latter were between two millstones. This fact also explains the more frequent occurrence of blastomatous growths in the parameniscular tissues (in the synovial and fibrous knee-joint capsule and in the paracapsular tissues). The benign tumors are the lipomas, fibromas, ganglioneuromas and neuromas, osteomas, myxomas, cystic xanthomas, lymphangiomas, and hemangiomas, while the malignant are the sarcomas, peritheliomas, and endotheliomas.

True meniscus tumors are rare. The author could gather only the following observations:

An intra-articular fibroma of the right external semilunar cartilage (Brunn); a rooster comb-shaped fibroma of the anterior border of an otherwise normal internal semilunar cartilage (Kott); a polycystic fibroma firmly fixed to the lateral semilunar cartilage (Serafini) (in this case, according to our present views, the author was dealing with a fibrosynovioma); a cyst of the semilunar cartilage coincidental with a benign xanthomatous giant-cell tumor (Paula Zaech-Christen); a xanthomatous giant-cell tumor arising from the femoral surface of the medial semilunar cartilage (Tobler); an angio-endothelioma, a xanthomatous giant-cell tumor of the right medial semilunar cartilage (Hepner-Eichbaum).

The literature dealing with the xanthomas of the semilunar cartilage (Speil, Mathey, Biebel) and the "Babylonian" classification mixup of these tumors, which cannot possibly be properly classified without further effort, are discussed. The author differentiates 3 types of formation:

1. Lipophagous xanthogranuloma, which is to be regarded as a metaplastic or resorption granuloma of the injured portion of the fat tissue of the knee joint.

2. Giant-cell blastoma of the knee joint, which has undergone true xanthomatous changes, and because of the continuous activity of the joint, there is a deformed and secondarily altered tumor in which xanthomatous deposits have formed as a result of destruction and resorption of the cells. This must be strictly differentiated from true sarcoma; it assumes an intermediate position between fibroma, to which it is closely related, and sarcoma.

3. A combination of a true giant-cell blastoma and angioblastoma with secondary xanthogranulomatous formation developing around traumatic or spontaneous tumor necrosis, or around nests of cholestrin crystals acting as foreign bodies.

Following these introductory considerations, the author reports an observation of his own which deals with a meniscus lipoma; the clinical history and an illustration are presented.

A twenty-three-year-old female salvation army officer, who had previously been well, experienced a severely painful crackling sensation on the medial aspect of the knee joint while riding a bicycle uphill. Following this, there remained persistent signs of locking and limitation of extension of the knee. While the knee was held in flexion at 120 degrees, a marked knocking could be felt and heard at the level of the medial aspect of the fissure of the joint and at the same time a tumorlike cartilaginous mass protruded from the depths of the joint space; this tumor disappeared on further flexion. Severe tenderness on pressure was elicited over the medial aspect of the knee joint, and the Steimann rotation sign was markedly positive in this region.

In the roentgenogram the medial knee-joint fissure was somewhat widened beyond the normal, and in addition to this there was a questionable shadow in the region of the outer semilunar cartilage. Upon opening of the knee joint through a medial arthrotomy incision, there was encountered at the anterior end of the medial meniscus, a lipoma about the size of 4 cherries divided into 3 or 4 main lobules; this lipoma was situated upon the outer and upper surface of the meniscus, was firmly fastened to the latter, and, upon flexion and hyperextension, was drawn in toward the joint and became firmly wedged in the latter. The meniscus, which was attached in a normal manner at its anterior and posterior point of anchorage, showed a longitudinal split in its posterior two thirds, as a result of which, the fragment, which remained connected with the meniscus in its posterior end, projected into the joint space. The meniscus together with the lipoma was removed. Postoperative convalescence was uneventful. After three months, the patient was able to carry out extension up to 180 degrees, active flexion to 90 degrees, and passive flexion to 70 degrees.

Histologically, in the region of the macroscopic tear, there was seen a swelling of the tissue. However, there was no evidence of foci of necrosis. The surfaces of the tear were covered by a flat endothelial-like layer of cells, as if a new formation of synovial epithelium had taken place in this region. The deeper layers of the surrounding tissue showed no noteworthy changes. There were numerous blood vessels of recent origin at the base of the meniscus at the point of transition to the synovial membrane, characterized by a prominent endothelium. The synovial membrane in many instances was very cellular. The fatty tumor consisted of loose, adipose tissue with occasional connective-tissue strands; its construction was slightly lobulated; the superficial surface was covered by the usual synovial tissue.

The first and only finding of a meniscus lipoma, and the pathological relationship between the tumor and the spontaneous rupture of the involved meniscus, are emphasized. The fat tissue presents a favorable medium for the development of lipomas; the initial recognition goes back to an observation of Beckels at the end of the 18th century, a condition which should be differentiated from the traumatic inflammatory proliferation of the so-called Hoffa's fat body. As far as synovial membranes are concerned, according to Hammar, a cell-rich and cell-poor type are to be distinguished; in the former type, according to Petersen, folds of fat of extremely variable form and size are found, whose convolutions are very similar to the muscle fiber distribution in the walls of comparatively large arteries. In the niches between these folds we encounter whole forests of synovial cells which provide, on the one hand, for the mucous membrane healing of the joint, and on the other, for the nourishment, oxygen supply, the production of heat, and the resorption of waste material. The subsynovial membrane, which up to the age of thirty is extremely cellular, loose, and markedly permeated with connective-tissue fibers, begins to sclerose after the age of forty-five because of the disappearance of the loose fat-containing tissue. In commenting on the fat in the semilunar cartilage, the author mentions the work of Tobler and Wallenheimo, according to whom the occurrence of fat droplets in the menisci is quite frequent. The author is not in accord with the assumption of Wallenheimo, that the fat infiltration in the cells of the superficial layer of the meniscus, which is already present at the age of puberty, disappears as the result of degenerative changes in later life. According to Henscher's opinion, the explanation for this finding is based upon a metabolic phenomenon whereby the fat infiltration is supposed to represent a nutritive material of an inferior grade which takes the place of the used-up tissue carbon of the cell glycogen which represents the best type of nourishment; this process, therefore, is not regarded as a choking-off

of the tissues by fat, but rather as a type of nourishing food stuff which is supplied to the tissue in accordance with the new type of functional or formative demands made upon the latter.

The problem of the occurrence of true fat tissue in the marginal region of the meniscus or of the parameniscular zone of tissue has not yet been clarified. According to Wallenheimo, especially in females between the ages of twenty and twenty-six, the apical third of the meniscus and the parameniscular tissue still appear very cellular just as in childhood, so that there might still be room for the heterotopic embedding of lipomas or lipoblastic bodies which have become separated from their original separation (deposition of fat cells—Fleming; primitive organs—Hammar). In view of the foregoing, we are dealing with a so-called heterotopic lipoma in the case at hand, i.e., with the development of fat in a place where normally no fat tissue occurs.

True lipomas have been observed in the knee joint as being subsynovial and outside of the joint, i.e., lipomas of the joint projecting out of the joint; and as subsynovial and within the joint (Diamant-Berger, Otterbeck). Schwartz found a 1½ kgm. lipoma of the knee joint. Lipomas of the fibrous capsule and the paracapsular layers of fat, arising from aberrant fat anlagen are more seldom observed. The case described has a certain parallelism with the broad-based egg-sized lipoma of the crucial ligament found at operation by Herrold.

The etiological relationship between the occurrence and presence of these meniscus lipomas and the development of a meniscopathy which predisposes to tearing of the meniscus is based upon the interference with the gliding freedom and gliding ability of the semilunar cartilage by the lipoma which may firmly anchor the anterior half of the internal semilunar cartilage. As a result, the physiological gliding motion and the ability of the meniscus to draw together to form a smaller arc is made impossible, and the meniscus is caught as if between 2 millstones; then, due to attrition, the meniscopathy, which predisposes to tearing of the meniscus, arises.

(Tilk). Harry A. Salzmann, M.D.

## SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

**Steindler, A., and Ruhlin, C. W.: The Conservative Compensation-Derotation Treatment of Scoliosis.** *J. Bone & Joint Surg.*, 1941, 23: 67.

Since in most cases of scoliosis it is impossible to secure anatomical restoration, measures which realign the spine by compensation—balancing the head and shoulders over the pelvis—are acceptable as a compromise. If adequate musculature is available to maintain balance, satisfactory results can be obtained. In the absence of such muscle power, fusion is required.

The cases are grouped into five types:

1. Those which compensate spontaneously and maintain their correction during the period of rapid growth and after adolescence. These are about 30 per cent of the total.

2. Those in which compensation can be secured conservatively and in which adequate muscle tone can be developed to maintain correction. The majority of slight and moderate habitual and rachitic scolioses belong in this group.

3. Those in which adequate compensation can be maintained, and in which adequate muscle power can be developed, but in which compensation is likely to break down because of marked adaptive or congenital osseous changes. This group, including the more severe, progressing habitual types and the congenital cases, probably should be fused.

4. Those in which alignment is possible, but muscle power is inadequate. These include most paralytic cases and probably should also be fused.

5. Those which cannot be adequately realigned because of severe structural deformity. This group comprises the most severe congenital cases, severe habitual scoliosis, severe paralysis, and severe cervico-thoracic rachitic scoliosis. If the curvature is progressing, fusion should be done. If stable, it should be left undisturbed or treated by support.

Treatment consists of systematic development of muscle tone and improvement of the mechanical efficiency of the muscles by symmetrical and asymmetrical exercises to develop the back, abdominal, and shoulder muscles, with the formation and maintenance of compensatory curves. During the period of muscle development a brace is applied to safeguard the maintenance of posture until the muscles are strong enough to hold by their own power.

If forced compensation is obtained by the use of a wedge-cast, fusion must be done to hold the correction. The authors further state that rotary deformity of the thorax cannot be corrected by any of our present methods of treatment.

Daniel H. Levinthal, M.D.

**Hackenbroch, M.: Operative Treatment of Certain Types of Arthritis Deformans of The Hip Joint. Critical Discussion of the Problem of Drilling the Femoral Head and Arthrodesis** (Zur operativen Behandlung bestimmter Formen von Arthrosis deformans des Hueftgelenks. Zugleich kritischer Beitrag zur Frage der Tunnelierung des Schenkelkopfes und der Pfannendachbolzung). *Ztschr. f. Orthop.*, 1940, 71: 238.

Disturbances in arthritis of the hips may be due to poor posture (pains due to exhaustion), to insufficiency of the cartilage (arthritic pains, particularly after considerable rest), and also to defects in the bone structure. Among the last the author considers the most serious to be certain non-inflammatory areas of rarefaction which are of congenital or embryonic origin and are combined with the occurrence of certain static-dynamic defects.

When the usual operative procedures fail (subtrochanteric osteotomy, Duvernay's drilling of the neck of the femur, resection), the cause usually is

failure to determine the precise cause of the difficulty which has been the primary indication for the surgery. In the cases with pure bone disturbances drilling of the femoral neck or arthrodesis may be most successful. The arthrodesis has the biological purpose of rebuilding the stability of the joint rather than the prevention of a further subluxation. Drilling of the femoral neck is a direct stimulus to the development of reconstruction changes in the head of the femur. This type of surgery is particularly suited to older people, since it is readily performed and the hip joint becomes functional after three weeks without any further need of plaster casts. The localization of the pathology in the acetabulum is indication for arthrodesis, whereas alterations in the femoral head are indication for surgery on the neck of the femur. Both procedures may be combined; also, the arthrodesis may be combined with a sub-trochanteric osteotomy. (Sievers). Jacob E. Klein, M.D.

## FRACTURES AND DISLOCATIONS

**Troell, A., Lauritzen, G., and Möller, A.: Fractures of Apparently Healthy Bone Without a True Accident.** *Acta chirurg. Scand.*, 1940, 84: 226.

Spontaneous fracture of apparently normal bone in 6 patients is described and the probable etiological factors are enumerated and discussed. An impacted fracture of the radial neck occurred in an eleven-year-old girl while she was sewing. No history of severe muscular effort or trauma in any form could be obtained, but this history was subject to question. Definite external trauma at a later date resulted in a fracture, not through, but closely adjacent to the original fracture site.

Fracture of the ulnar diaphysis occurred in 2 young women who gave an identical history of experiencing sudden, sharp pain in the forearm while pitching hay. A fracture of the lateral malleolus of the right tibia occurred in a middle-aged man while he was attempting to lift an extremely heavy weight. Fractures of spinous processes about the cervicodorsal region occurred in 2 younger men; 1 of these patients noted the onset of upper back pain while shoveling snow while injury in the other occurred while he was excavating with a crowbar. There was no history of external violence in any case, and in none of the 6 patients was there roentgenological or clinical evidence of either local or systemic disease.

The authors believe that spontaneous fractures may be classified under three groups: (1) spontaneous fractures due to insufficiency of phosphorus and calcium in the skeleton; (2) spontaneous fractures as a complication of tetanus convulsions following metrazol therapy of the insane; (3) fractures caused by, or occurring in connection with, violent muscular action. All but the first of the 6 cases cited were placed under the third classification. No explanation was offered for the radial neck fracture in the first patient.

In conclusion it was stated that fractures may occur in almost any healthy bone of persons who, exposed to exacting work or fatiguing labor, attempt unaccustomed or unusual exertion.

Homer Pheasant, M.D.

**North, J. P.: The Conservative Treatment of Fractures of the Humerus.** *Surg. Clin. North Am.* 1940, 20: 1633.

The author discusses briefly the treatment of fractures of the upper end of the shaft of the humerus. In fractures of the surgical neck with little or no displacement, the use of a sling and swathe is advised. The importance of early active motion, begun gradually four or five days after the injury, is stressed. Fractures of the surgical neck with considerable displacement may result in excellent functional results even though reduction is imperfect. If reduction can be accomplished, the arm can usually be brought to the side and maintained in a sling and body swathe. A plaster abduction spica cast may be required. Occasionally balanced traction may be employed.

In the treatment of shaft fractures, the Caldwell hanging cast is recommended. The author recognizes that the method is unorthodox since it does not immobilize the proximal fragment, but states that it works in actual practice despite flagrant violations of the accepted principles.

Daniel H. Levinthal, M.D.

**Hinton, D., and Steiner, C. A.: Fractures of the Shaft of the Radius and Ulna.** *Surg. Clin. North Am.*, 1940, 20: 1669.

This article concerns itself with simple fractures of the forearm which are not displaced or are reducible by manipulation. For general anesthesia the authors prefer vinethene, except in fluoroscopic reductions for which gas-oxygen is used. Immobilization is maintained by anterior and posterior splints.

For fractures of the radius above the insertion of the pronator teres, the supinated position is employed, while fractures at a lower level are healed in midpronation. Splints are removable for the early institution of physical therapy.

Daniel H. Levinthal, M.D.

**Manges, L. C., Jr.: Fractures of the Lower End of the Radius (Colles).** *Surg. Clin. North Am.*, 1940, 20: 1683.

In this discussion of Colles' fractures, Manges stresses particularly the importance of the radioulnar articulation. In a concise description of the anatomy he reviews the salient features and includes the ligamentous structures as well as the bony ones. Taylor and Parsons' classification is employed, namely:

1. Fractures with the triangular ligament intact
2. Fractures with loss of integrity of the radioulnar joint
   - (a) Rupture of the triangular ligament
   - (b) Avulsion of the ulnar styloid
   - (c) Severe comminution of the lower end of the radius

The use of general anesthesia is recommended for reduction, the author believing that local anesthesia has not been satisfactory. In fractures without displacement, he employs a short molded posterior splint with the wrist in neutral position. For fractures with displacement but with an intact triangular ligament, reduction is maintained by a short posterior plaster splint with the wrist in fairly acute flexion. For fractures with disturbance of the radio-ulnar articulation the wrist must be held in strong ulnar deviation as well as flexion and an anterior molded splint is advocated in addition to the posterior plaster. Early active motion is desirable.

When these cases are efficiently handled, the prognosis is good. However, from a review of several reported series the author finds that poor results are obtained too frequently, which indicates that this fracture is being handled either carelessly or inadequately.

Reversed Colles' fractures are reduced by a procedure practically reversed to that used for Colles' fractures. Hyperextension of the wrist is to be avoided. Epiphyseal separations of the lower end of the radius are handled in much the same manner as typical Colles' fractures. Repeated manipulations are to be condemned since they may result in destruction of the growth cartilage of the epiphysis.

DANIEL H. LEVINTHAL, M.D.

**Barr, J. S.: Fracture of the External Tibial Condyle.** *J. Am. M. Ass.*, 1940, 115: 1683.

Fracture of the upper end of the tibia has been recognized as an extremely serious injury, not because of non-union, which rarely if ever occurs, but because it involves a weight-bearing joint and the risk of loss of normal knee-joint function. The degree of displacement of the fractured fragments is the key to rational treatment. In cases with a minimal displacement, the author's method is immobilization in a carefully molded plaster cast or splint, or in a Thomas splint with a Pearson attachment and with the knee in slight flexion until the swelling of the joint has subsided. This usually requires from one to two weeks. Daily physical therapy is then instituted. Gentle active movement of the knee, always within the limits of discomfort, is added to this within another week or two.

Cases with from slight to moderate displacement were the ones presenting displacement of fragments from ¼ to ½ in. The author treated 3 of these cases conservatively. One patient was treated by closed manipulation and 3 were subjected to open operation. After a year of follow-up study he is not ready to express favor for either form of therapy and believes that the ultimate preference will depend upon the cases which develop instability, pain, and degenerative joint changes.

The third group of cases, numbering 8 in the author's series, had displacement of fragments amounting to ½ in. or more as estimated from the roentgen-ray appearance. These cases must be subjected to open operation. If the condition is unrecognized or deliberately left unreduced, the result is a painful weak knee which upon examination shows marked abnormal lateral mobility, increasing knock-knee, deformity, and hypertrophic changes which occur as time elapses. Manipulation cannot possibly affect anatomical reposition of the joint surface of the tibia.

The operative technique calls for a bloodless field. The incision begins 1 in. lateral to the superior pole of the patella and extends downward just lateral to the tibial tubercle, then curving outward, it ends at a point 4 in. below the joint line just anterior to the fibula. The joint is then carefully inspected through a longitudinal incision in the capsule just lateral to the patella. In order to visualize the extent of the fracture it is usually necessary to remove the external semilunar cartilage. Afterward, the whole articular surface of the outer condyle of the tibia is usually exposed. Subperiosteal stripping of the common origin of the extensor muscles from the anterolateral surface of the tibial condyle will expose the longitudinal fracture. Depressed fragments of articular cortex with cartilage attached may be replaced by means of a blunt dissector or a bone-grasping forceps. In some instances additional bone chips removed from the tibial shaft may be packed beneath the replaced fragments. The articular cartilage of the tibial condyle should present after this step a smooth anatomical restoration of normal contour. Without this the operation is a failure. The lateral fragment is then replaced snugly, so that it locks the other fragments in jig-saw-puzzle fashion. The most satisfactory method of securing anchorage of this fragment is by bolting a Sherman screw with a washer over the head, and a nut on the free end. After the sutures are removed and the postoperative reaction has subsided the same program is carried out as for fractures with minimal displacement. The screw is not removed unless it shows signs of bone absorption, although the author believes that all metal should be out within one year after its introduction.

ANTHONY F. SAVA, M.D.

**Ahlberg, A.: Review of 111 Cases of Fracture of the Calcaneus, with Especial Reference to Injury of the Talocalcaneal Joint** (Studien ueber 111 nachuntersuchte Faelle von Calcaneus-frakturen unter besonderer Beruecksichtigung der Gelenkschaeden zwischen Talus und Calcaneus). *Gothenburg: Dissertation*, 1940.

About 160 patients with fractures of the os calcis were observed between the years 1925 and 1937, but only 111 could be followed up. Eleven of these had bilateral injuries. Sixteen, or 14.4 per cent, were women, with an average age of forty-five and three-tenths years, and 95, or 85.6 per cent were men, with an average age of forty-three and six-tenths years. All of the bilateral fractures occurred in men. The fractures are divided into three groups according to the severity of the injury: (1) fractures of the process of the os calcis without involvement of the joint (17

cases, 13.9 per cent); (2) fractures, fissures, or fracture lines which involve the talocalcaneal joint, but in which there is little or no displacement of the fragments (10 cases, 8.2 per cent); and (3) fractures which directly or indirectly have caused a derangement of the joint (95 cases, 77.9 per cent). In 26 cases (23.4 per cent) the fracture of the os calcis was associated with other fractures but only 5 times with vertebral fractures. Five fractures were compound, the other 117 were simple. The simple fractures were treated as follows: 43 with bed rest (with or without splints), 48 with plaster casts (with or without reduction), 12 with traction, 5 with compression by means of Boehler's os-calcis clamp, 3 with reduction according to the method of Boehler, 1 by reduction according to Westhues, 1 by open reduction, and 1 with reduction according to the method of Lenormant and Wilmoth. Most of the patients had plaster casts in later treatment, and, in addition, passive and active exercises, massage, and diathermy; in most of the cases supporting inner soles were ordered. The average duration of treatment amounted to thirty-eight or thirty-nine days for the unilateral single fractures, and eighty-six or eighty-seven days for the bilateral fractures, an average of fifty-eight or fifty-nine days, and the complete duration of economic disability was from five and three-quarters months to six and one-half months for the insured patients, and four and one-half months for the others. In the bilateral os-calcis fractures the average duration of economic disability was seven and one-half months. As to complications there was 1 necrosis of the skin and 1 pulmonary embolism. With the cases arranged according to severity the patients in Groups I and II were disabled economically for an average of three months, and those in Group III for an average of five and one-half months. No complete anatomical reduction was procured in the 91 fractures of Group III. With regard to the early results, 45, or 49.4 per cent, of the cases showed a joint angle which was 0 degrees or negative, and only 7 showed an angle of over 20 degrees. Dorsiflexion was absent in 8 of the 37 older patients and in 3 of the 27 younger patients; and it was under 20 degrees in 28 of the older patients and in 14 of the younger patients. Plantar flexion was under 30 degrees in 8 patients of the younger group and in 13 of the older group. Of interest is the fact that in the late results pronation and supination had become worse in 56.6 per cent of the cases in which these movements could be compared with the early results. Pronation was improved in only 10 per cent of the cases and supination in 16.7 per cent, while they remained unaltered in 33.3 per cent and 26.7 per cent, respectively. Special methods of measuring the movements of the ankle joint are described.

In the follow-up studies, which extended from over nine months to thirteen and one-half years, the following late results were found:

Among 119 patients with single fractures there were 19, or 21 per cent, of Groups I and II who had normal motion as compared with the healthy foot; in 39, or 32.8 per cent, the motions were hampered; in 41, or 34.4 per cent, both pronation and supination were restricted; and in 14, or 11.8 per cent, there was neither pronation nor supination. In Group III, 6, or 6.4 per cent, had normal motion; 39, or 42.4 per cent, were hampered; in 37 both pronation and supination were limited; and in 10, or 10.9 per cent, either pronation or supination was limited.

In the older patients the figures were uniformly less favorable than in the younger ones. Seventy-five patients, or 67.5 per cent, returned to their previous jobs; 29, or 25.2 per cent, had to take lighter work or change their jobs; 7 did not resume work again. Of the last, 2 had concomitant knee injuries, 1 had a vertebral fracture, 3 were prematurely pensioned off, and 1 was financially independent.

Of the insured patients, 16, or 23.9 per cent, were receiving no compensation at the end of their period of economic disability, and 28, or 40.8 per cent, were receiving none at the completion of the follow-up study. Thirteen, or 40.6 per cent, of the patients of the younger group and 15, or 42.8 per cent, of the older group received long-term compensation, and this in the former group amounted to from 10 to 15 per cent in 8 cases and from 20 to 35 per cent in 5 cases; in the older group from 10 to 15 per cent in 6 cases and from 20 to 60 per cent in 9 cases. Only 3 patients with single fractures of the os calcis were concerned with compensation, whereas all of the other patients had suffered multiple fractures. In addition, there are in this work innumerable proofs of the existence of flat, pronated, and flat-pronated feet, of varus and adduction deformities of the foot, also of bony projections below the ankle, shortening of the height of the malleolus from the ground, change in gait, muscle atrophy, inability to stand on tiptoe, pain on weight-bearing, disturbances of sensation, roentgenological deformities of the os calcis, bone atrophy, and long duration of subjective discomfort. In a small group of cases it was attempted to improve the results of the initial treatment by secondary measures. Periarticular injection of 1 per cent aethocain was unsuccessful; arthrodesis of the lower ankle joint, on the other hand, is to be heartily endorsed in cases of longstanding pain.

(Werner Block). Richard Warren, M.D.

**Ahlberg, A.: The Results of Treatment in the More Severe Fractures of the Os Calcis** (Ueber die Behandlungsergebnisse bei schwereren Fersenbeinbruechen). *Acta chirurg. Scand.*, 1940, 84: 187.

Numerous methods of treating fractures of the os calcis have been proposed and used with more or less success but no one method has been found to be ideal. The experience and the skill of the individual surgeon seem to play an important part, both as regards the selection of suitable cases and the carrying out of the treatment, and the best results are probably achieved by an individual combination of different methods of treatment.

The author has followed up 111 cases with 122 fractures of the os calcis, of which 95 fractures in 88 patients are discussed, namely, those of the more severe sort with direct or indirect involvement of the posterior talocalcaneal joint and dislocated fragments, corresponding with Groups V to VIII of Boehler's classification. In well over 60 per cent of the cases the follow-up examination was made five years after the accident. In none of the cases was complete anatomical restoration to be noted, not even when active therapeutic measures had been undertaken. The mobility in the lower ankle joint could be considered normal in only 6 cases on follow-up examination. In the other cases it was either absent or limited. It can also be stated that the mobility seems independent of whether the joint surfaces have become anatomically restored or not. For years numerous patients had had painful symptoms after the accident, and as a rule they were apparently due to injuries of the joint. The changes to the joints occasioned by the fracture seem to develop irrespective of the therapeutic methods, according to the nature of the fracture. The author agrees with those authors who, after earliest possible reduction perform a subastragaloid arthrodesis from four to five months after the accident in the event that the symptoms persist.

The symptoms that indicate joint changes include pains on walking on uneven ground, missteps and imbalance of the foot, pains when attempting forced motions of the lower ankle joint, and stiffness of the foot after rest. The character and localization of the symptoms are also important. It is not surprising that a joint, which must bear the weight of the whole body, reacts painfully when it must function. Even though protruding portions of bone, plantar as well as that below the ankle, are of some degree of significance for the permanent symptoms, they deserve only secondary consideration.

In agreement with others, the author believes that in these cases a subastragaloid arthrodesis is indicated. Many of the patients are thereby spared suffering for years, even though in some cases the symptoms do not disappear entirely. The author also believes that immediately after the admission of the patient the recent fracture should be reduced in the usual way, namely, by restoration of the anatomical relationships as much as possible, even though it may not be complete, in order that the later intervention need not be so extensive, and include the chiselling off of exostoses. Hermann first accomplishes a reduction and about four and one-half months later he performs a subastragaloid arthrodesis in the cases in which the symptoms persist. This period of time is advantageous because there is opportunity of allowing the patient to step on his foot and of observing any malpositions, which can then be corrected in the course of the operative procedure.

Some surgeons undertake an arthrodesis not only of the posterior talocalcaneal joint, but also of the entire Chopart joint. The lateral incision alongside the peroneal tendons is used, so as to obtain a good general view of the joint. The goal of the treatment for these fractures may be set as complete anatomical and functional restoration but, unfortunately, one finds that a completely satisfactory result is not obtained and, instead, the subjective symptoms of the patients must be the decisive factor.

LOUIS NEUWELT, M.D.

# SURGERY OF THE BLOOD AND LYMPH SYSTEMS

## BLOOD VESSELS

**Meyer, O.: Latent Phlebitis as the Cause of Gangrene** (Latente Phlebitis als Ursache von Gangraen). *Muenchen. med. Wchnschr.*, 1940, 1: 581.

Nearly one-half of all amputations of the thigh can be avoided if early attention is paid to latent phlebitis and if a suitable treatment is instituted. Each inflammatory process is accompanied by an edema of the inner layer of the walls of the veins, which leads to a diminution in the size of the lumen. This in turn may produce a venous congestion, which should be looked for in each case of gangrene of the toes. A search for a pulsation of the arteries of the feet is not sufficient, especially in the presence of an edema. If an arterial pulsation cannot be detected, an attempt should be made to record a pulse curve with a special apparatus. The author uses the Cambridge pad which consists of an extremely thin semiglobular rubber bag filled with glycerine. A latent phlebitis may be detected by means of pressure points described by the author previously (*Muenchen. med. Wchnschr.*, 1927, p. 721; 1933, p. 455).

The author recommends the therapeutic measures suggested by Fischer. They produce a standstill of the gangrene and in early cases even a complete recovery. The author was able to avoid high amputation in each case and found it sufficient to remove only the gangrenous portion immediately above the demarcation line. Attention should be paid to sources of a focal infection, such as the teeth or tonsils, because a latent phlebitis of the jugular veins may originate there. The subject is of great importance for war surgery.

(D. Blos). Joseph K. Narat, M.D.

**Bauer, G.: A Venographic Study of Thrombo-Embolic Problems.** *Acta chirurg. Scand.*, 1940, 84: Supp. 61.

By a new and promising method, the deep veins of the lower leg are made visible on the x-ray film and the thrombo-embolic process can be studied in its earliest stages. The objective of the author in the work reported herewith is to discuss what may be gained by this type of venography and to submit his conclusions from a venographic study of available material. Briefly his technique is as follows:

The patient is placed on his back on the operating table with a casette under the affected leg, its lower edge about 10 cm. above the malleolar level. Under local anesthesia an incision about 2 cm. long is made behind the external malleolus. The vertical vein is isolated and lifted by silk threads. After injections of physiological saline solution to insure free passage, a syringe containing 20 c.cm. of 35 per cent perabrodil is fitted to the needle. By accurate timing the injection is made steadily through an interval of 60 seconds. The x-ray exposure is made immediately. For venography of the pelvic veins, the large saphenous vein is used.

From the study reported extensively, the author concludes that thrombo-embolic disease almost invariably starts in the great deep veins of the lower leg. Its earliest stages can usually be unmasked there with the aid of venography. Therefore, a venographical examination should be made immediately when even the slightest clinical signs of an incipient thrombosis manifest themselves in a patient.

If this examination results in no opaque filling of the veins within the lower leg, whereas the femoral vein is well filled, a treatment consisting of elevation of the foot of the patient's bed in conjunction with the routine administration of heparin ought to be instituted immediately. If no shadow of the femoral vein shows up on the venogram, there are two possibilities. One is that there is already tenderness over this vein and swelling of the thigh, i.e., signs of a firmly adherent thrombus in the femoral veins. Heparin treatment then confers no local benefit, but should none the less be used to prevent further propagation of the thrombus within the pelvic veins or another thrombosis arising in the lower leg.

The other possibility is that the absence of filling in the femoral vein does not coincide with any tenderness over this vein. The greatest watchfulness is then imperative. The risk of pulmonary embolism is great. Treatment should consist of raising the foot of the patient's bed as well as of energetic heparin administration. In addition, the medical attendant must be ready to intervene surgically by way of vein ligation.

The least deterioration of the condition in the shape of one or more pulmonary infarcts, rising temperature and pulse, or an especially active process in the lower leg (intense tenderness, pains), is an indication calling for operation. The uppermost part of the large saphenous vein is exposed by means of a short vertical incision. Through this venography is made. If the common femoral vein shows up well filled with the opaque medium, the incision can be extended, and ligation with resection can, as a rule, be done at the most ideal spot, just below the origin of the profunda. In these cases the postoperative symptoms are slight.

Should the thrombosis extend upward past the origin of the deep femoral vein, a ligature can also be applied to the common femoral vein, if the latter is found to be free of thrombosis at any point. In these cases the postoperative symptoms are somewhat more pronounced.

If venography shows that the common femoral vein also is totally obliterated, there is no means of judging the proximal extension of the thrombosis, and recourse to ligation should be made only in rare and exceptional cases. In chronic thrombosis as

well, venography often gives valuable information that can be turned to good therapeutic account.

HERBERT F. THURSTON, M.D.

## BLOOD; TRANSFUSION

**Bushby, S. R. M., Kekwick, A., Marriott, H. L., and Whitby, L. E. H.: The Survival of Stored Red Cells After Transfusion.** *Lancet*, 1940, 239: 414.

When a transfusion is given for anemia, the important element in the blood is the red cell. Also, with severe hemorrhage, a transfusion is often designed theoretically to restore red-cell elements so that oxygen-carrying power may be increased. However, with acute hemorrhage and more especially with wound shock there are other more important advantages to be gained from transfusion, viz.: (1) restoration of blood volume; (2) restoration of blood protein; and (3) restoration of a reasonable blood pressure. The authors are concerned with that which is designed to restore the red-cell elements.

They noted that every transfusion of blood to which no glucose was being added and which had been stored for more than two days caused a detectable increase in plasma bilirubin, even though no clinical jaundice was present. Experiments which they conducted suggested that the rises in plasma bilirubin were due to hemolysis of transfused cells *in vivo*, and that the circulating pigment was derived from fragile cells contained in the transfused specimen.

The only true test of whether transfused red cells endure in the recipient is to follow the fate of the cells by repeated examinations. For this a simple blood count is insufficient because it does not show whether rises or falls in a total count are due to autogenous cells or to the transfused blood. However, when Group O blood is given to a Group "N" patient and vice versa, the fate of the transfused blood can be observed by making counts of the cells not agglutinated by an appropriate serum.

The following have been investigated for their influence on the fragility of stored blood: (1) carbohydrates, (2) citrate and other anticoagulants, (3) dilution and plasma factors, (4) saline, (5) temperature, (6) acidification, (7) oxygenation, (8) enzymes and leucocytic action, and (9) sundry other factors. Of the single factors, glucose is outstandingly the best. The enhancement given by glucose and dilution, or by glucose, dilution, and acidification is recognizable as such, but the degree is not sufficient to justify utilization for the practical storage of blood.

Brewer *et al.* have reported that stored blood from ten to fourteen days old which contains glucose, is as efficient as fresh blood for the treatment of acute hemorrhage. The authors confirm this statement and show that even older blood survives a reasonable time in the recipient, and certainly long enough to keep a wounded man alive until he arrives at the place where he can receive complete surgical care.

Such was the experience in recent campaigns, during which some 500 transfusions of blood from ten to thirty days old were given. Further, this old blood appeared to cause a negligible number of reactions, even though it had been subjected to the batterings incidental to transport. This good preservation may have been due partly to the Army system of "topping" the bottle so that it is completely filled, all air excluded, and no slopping possible. De Gowin *et al.* found that hemolysis was delayed when blood was stored in sealed air-displaced flasks, as compared with blood exposed to air.

It is clear from the bilirubinemia which is associated with the transfusion of stored blood that the older the blood the more rapidly are its fragile corpuscles destroyed. The iron pigment thus set free is phagocyted by the reticulo-endothelial system and assists in blood regeneration during convalescence from hemorrhage. Provided that the blood is not so old as to liberate suddenly a dangerous quantity of pigment, the transfusion of even quite old blood to the exsanguinated has much to commend it.

HERBERT F. THURSTON, M.D.

**Maizels, M., and Paterson, J. H.: The Survival of Stored Blood After Transfusion.** *Lancet*, 1940, 239: 417.

There are several ways in which the value of stored blood may be investigated: (1) by clinical observation; (2) by the increase in the recipient's hemoglobin brought about by transfusion, and the permanence of this rise; (3) by the direct demonstration of the persistence of the donor's cells in the circulation of the recipient.

The degree of persistence of the donor's cells after transfusion affords the most direct and positive evidence of the value of transfusion of stored blood. This third method was adopted in this investigation, which deals with the survival of stored blood-cells measured with iso-agglutinins and with changes in the chemistry of stored blood cells in the recipient's blood after transfusion. Transfusions have been carried out with blood and citrate solution mixed in the proportion of 2 to 1. The citrate solution contained sodium citrate (1.05 per cent), sodium chloride (.85 per cent), and glucose (3 per cent).

Ashby devised a method of measuring the survival of erythrocytes after transfusion of fresh blood by the use of Group O donors for Group A recipients. Blood was withdrawn from the recipient before transfusion and at suitable intervals afterward and mixed with Group B serum. The recipient's *A* cells were agglutinated while the donor's *O* cells remained free and were counted. It was assumed that the number of free cells present at any given interval after transfusion represented the number of transfused cells surviving at that time.

It has been shown that stored erythrocytes often contain more than four times as much sodium as do fresh cells. Since it is known that stored cells survive for many days after transfusion, it was thought of interest to measure what changes took place in

the chemistry of the donor's cells after they had reached the recipient's circulation.

The sodium content of the erythrocytes of stored blood is several times greater than that of the recipient's cells before transfusion. Immediately after transfusion there is a rapid rise in the level of the sodium of cells in the recipient's circulation. However, in almost every instance the sodium level returned within twenty-four hours to that found in the recipient's cells before transfusion. This can only mean that the transfused cells have been destroyed, or that they have been chemically "reconditioned" with the result that the great excess of sodium is removed and replaced by its equivalent of potassium. The disappearance of sodium is not accompanied by a corresponding fall in the count of donor's cells, and it is therefore necessary to conclude that the rapid return of sodium to normal is due to a process whereby the excess of sodium is removed and replaced by potassium.

Since this ionic exchange between the donor's transfused cells and the recipient's plasma must take place against a steep concentration gradient, it cannot be due to any simple physical process. Possibly, the spleen, which is known to produce changes in the surface of erythrocytes, may play a part.

In conclusion, the authors note that stored blood survives for considerable periods after transfusion. Red cells stored for less than a week show about 70 per cent of survival fourteen days after transfusion. If the storage is between seven and fourteen days, more than half the transfused red cells are still present in the recipient's circulation fourteen days after transfusion. During storage normal cells lose potassium and take up a great excess of sodium. Within twenty-four hours of transfusion the chemistry of stored cells is restored to normal.

HERBERT F. THURSTON, M.D.

**Buttle, G. A. H., Kekwick, A., and Schweitzer, A.: Blood Substitutes in the Treatment of Acute Hemorrhage; An Experimental Evaluation; Standard Conditions, Control Experiments, Plasma and Serum, Clinical Application.** *Lancet*, 1940, 239: 507.

In order to meet the need for immediate treatment of many widely scattered injuries occurring in war some substitute for the transfusion of whole blood must be found.

The authors have carefully studied the results obtained in cats bled in a standard fashion and given whole blood, saline solution, glucose, gum acacia-saline solution, 25 per cent hemoglobin-Ringer, red blood-cell-saline suspension, blood plasma, blood serum, and various types of dried serum. All the controls died. All those given whole blood survived and maintained stable blood-pressure levels. Those given either saline solution or glucose died after a somewhat longer survival period than the controls. The mortality was about 50 per cent after gum-saline solution or a cell-saline suspension. Those given 25 per cent hemoglobin-Ringer solution survived but had a respiratory disturbance and an unstable blood pressure. All those given either filtered or unfiltered blood plasma survived and showed no disturbance. Reactions occurred in 5 of 7 serum transfusions, 3 of them being severe. The same type of disturbance occurred after the administration of dried serum. Plasma-saline solution gave a temporary rise in the blood pressure but this was not maintained.

Plasma containing the smallest amount of crystalloid diluent possible is concluded to be the only available fluid which will approximate the results of whole-blood transfusions. Serum is next in order but was not recommended because of the reactions which were experienced. The scant literature on the subject indicated that blood plasma may be safely stored and filtered.

The authors state that the Army Blood Transfusion Service has had encouraging clinical results with filtered blood serum.

THOMAS C. DOUGLASS, M.D.

**Aylward, F. X., Mainwaring, B. R. S., and Wilkinson, J. F.: The Concentration and Drying of Plasma.** *Brit. M. J.*, 1940, 2: 583.

The authors enumerate the available methods of concentration of blood plasma: distillation from frozen serum, by means of a high vacuum and a desiccant such as phosphorous pentoxide, and spray distillation in vacuum. They describe in detail the last mentioned method but state that the apparatus is expensive and the output small. Another method investigated by them was the evaporation of liquid after dialysis through a cellophane membrane. They stress the importance of early separation of the serum before hemolysis has occurred. The concentrated plasma produced by these methods renders prolonged storage with little space possible and has all the advantages of the dry serum.

THOMAS C. DOUGLASS, M.D.

**Brown, H. A., and Mollison, P. L.: Note on the Transfusion of Reconstituted Dried Human Serum.** *Brit. M. J.*, 1940, 2: 821.

The usefulness of plasma and serum in the treatment of shock and even acute hemorrhage is now recognized, but there is some uncertainty as to whether serum has any disadvantages as compared with plasma. The authors review the opinions expressed by many writers in the recent literature. They have observed that wide experience from all serum centers indicates that properly prepared serum is safe. In the observations reported herewith the object is to point out that the dried serum emanating from the Medical Research Council drying unit at Cambridge is not only safe but efficacious.

Ninety-one transfusions of this serum have been given. Most of the serum used was from donors of Group AB. Some serum of Group A and some pooled serum were also given. In most cases the serum was administered in four-times-normal concentration by reconstituting the dried powder to

only a quarter of the volume of the original serum. One of the disadvantages of using these high concentrations is the rather long time taken for complete solution. This can materially be reduced by vigorous shaking of the dried serum before adding the distilled water, so that all lumps are well broken up. The water for solution should be warmed to 40° C. before addition.

It was considered that unequivocal evidence of clinical improvement was found in 28 of 44 transfusions. It is clear that the results are better when larger doses are given; not less than the equivalent of 400 c.cm. of normal serum should be administered initially, while larger quantities will almost certainly be required in severe cases. After the 91 transfusions 7 febrile reactions were noted. There were 6 cases of vomiting, 2 of urticaria, and 3 of lumbar pain. During 3 of the transfusions of four-times-normal serum, the patient complained of severe pain, cramp-like in nature, referred to the lumbar region. The pain in some instances radiated to the sacral region. The symptoms were of short duration and were not followed by further symptoms or signs. Although there was no reason to expect a hemolytic reaction, nevertheless, direct matching tests between the serum given and the corpuscles of the recipient were performed in these cases of lumbar pain, and no agglutination could be observed. Moreover, there was no hemoglobinuria in any of these cases.

When the results reported herewith are combined with the results from other sources, obtained personally, it is found that a record of 202 transfusions of dried serum is available; among these there were 34 reactions, practically all of them mild. Reactions occurred in 8 of 30 plasma transfusions. This reaction rate after a small series of plasma transfusions has been noted for comparison. Little difference between the two series is evident.

HERBERT F. THURSTON, M.D.

# SURGICAL TECHNIQUE

## OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

**Hayes, S. N.: Imperfect Sterilization of Dressings as a Probable Cause of Postoperative Tetanus.** *Brit. M. J.*, 1940, 2: 825.

In the past, imperfectly sterilized catgut has often been blamed for cases of postoperative tetanus. In spite of the present carefully controlled preparation of catgut, cases of postoperative tetanus continue to be reported. As a consequence, the author suspects that improper sterilization of surgical dressings may be a factor in the production of these cases, and he presents experimental evidence to show that tetanus spores persist in dressings when care is not used in the autoclaving process.

Cotton wool is a material prone to harbor tetanus spores and because of its tendency to expand on heating, it resists the penetration of steam. It is essential (1) to pack drums loosely with this material, (2) to use perforated drums, and (3) to expel all air from the autoclave by means of an adequate air vent at the bottom of the sterilizer. If these three conditions are carried out, the experimental work of the author shows that spores are invariably killed. LUTHER H. WOLFF, M.D.

**DeTakats, G.: Postoperative Thrombosis and Embolism.** *Illinois M. J.*, 1941, 79: 25.

There are 3 important factors which predispose individuals to postoperative thrombosis:

*Hemoconcentration.* Whenever blood loses some of its fluid content the clotting tendency is increased. This occurs not only in dehydration due to vomiting, inability to take liquids by mouth, or diarrhea, but is typical of the delayed secondary shock following operations or burns. It is also present in conditions in which the blood protein is diminished, because the fluid then passes out into the tissues, as in nephrosis, peritonitis, or conditions with a large fibrinous exudate in the pleural cavity. This hemoconcentration is most easily detected by red-cell count and hemoglobin determination. When it is found, its correction must be attempted by the restoration of fluid balance and of blood proteins.

*Slowing of venous return.* The drainage of venous blood from the lower extremities and pelvis is markedly retarded after operations. The factors responsible for this are (1) fall in the arterial pressure; (2) decreased diaphragmatic excursions, which greatly influence the emptying of the vena cava; (3) increased intra-abdominal pressure, due to distention and tight dressings; and (4) Fowler's position, which creates a venous pool in the pelvis. When these four factors are overcome, much will have been done to stimulate the venous return. The most potent stimulus for venous backflow is active muscular movement, and the postoperative patient should be encouraged to do this after the third day. Prolonged immobilization always carries a higher risk of thrombosis and embolism.

*The meteorological factor.* It has been found that during the spring and fall more emboli occur; the summer months are comparatively exempt. Marked deviations from the mean temperature during any particular period also seem to have an influence on the mobilization of blood clots. A similar effect of the weather on the thrombosis preceding the embolism is unmistakable.

The early, premonitory symptoms of thrombosis must not be overlooked—a small rise in the evening temperature; a persistently elevated pulse rate without any evident cause; an elevation of the skin temperature of the sole of the foot on the affected side; pain on pressure on the sole of the foot, on the calf muscles, in the popliteal space on dorsiflexion of the ankle, or in the groin; a slight edema of the groin or in the suprapubic region; frequent urination or mucous stools, and pain in the small of the back. The last three symptoms are suggestive of pelvic thrombosis, while the location of the pressure pain often denotes the site of the original thrombus.

The objectives of treatment are to free the limb of the edema and to protect the patient, as far as possible, from propagating thrombosis and embolism. The treatment is discussed in detail.

Many small pulmonary emboli go unnoticed. The three leading symptoms of pulmonary embolism are dyspnea, cyanosis, and chest pain. The associated fall in blood pressure is evidenced by the weakness and rapidity of the pulse. Abdominal symptoms often suggesting gall-bladder colic occur. The emergency and delayed treatment of pulmonary embolism is discussed. SAMUEL KAHN, M.D.

**Leun, W.: The Prevention and Treatment of Distant Thromboses with Elastic Adhesive Bandages** (Verhuetung und Behandlung der Fernthrombosen mit elastischen Klebekompressionsverbaenden). *Muenchen. med. Wchnschr.*, 1939, 2: 1271.

The author has had nine years of experience with the H. Fischer bandage, having applied 900 bandages on 600 patients. The results are very favorable in the treatment, as well as in the prevention, of thrombophlebitis. Sonntag and Mueller have treated 2,000 cases of acute thrombophlebitis, and consider the older treatment of bed rest, elevation, and moist applications to be erroneous. H. Fischer observed 2,400 cases of phlebitis of the leg and thigh without an embolism. E. Fischer observed no fatal emboli in 2,000 cases, but had from 12 to 15 small infarcts.

In the Pitzen clinic, this bandage has been applied 400 times in 320 patients with thrombophlebitis of the superficial or deep veins, with or without

fever. Only in the presence of a simultaneous pharyngeal thrombosis was conservative treatment used, without the adhesive bandage. There were 5 cases of fatal and 2 of mild embolism. In the former, however, the thromboses were in the pelvic and not in the peripheral veins. In the 2 milder cases, the cause was probably the same, but even if the embolisms were ascribed to distant thromboses, the results were still good in view of the usual statistics of embolism in from 17 to 57 per cent of the cases (Martini and Opitz, Podleschka, Ranzi, and Huber).

Heretofore, there has been no method by which the progression of thromboses or of embolism could be prevented. The further advantages of the bandage are: (1) the patient can get up immediately after the application of the bandage, and (2) pain and fever disappear at once.

In addition, the bandage has been applied prophylactically in the clinic, 500 times in 280 patients. There were apparently only 3 failures. All other prophylactic measures are less effective. In the failures, the bandages had become loose and were not reapplied. The technique of bandaging is described in detail, and should be read in the original. Elastophage bandages for the foot are to be 6 cm., for the leg 8 cm., and for the knee and thigh 15 cm. The bandage is cut after every turn. Half of the upper turn always covers half of the one beneath. Only at the knee is the overlap but 2 cm., in order to prevent disturbances in motion. Cotton padding is used under the foot and in the popliteal space. Semilunar felt pads are used under the malleoli. It is important in prophylaxis, as well as in therapy, that the bandage be applied under constant tension. In acute thrombophlebitis above the fossa ovalis, a pad is applied over the femoral vein in the form of a cotton wad 3 cm. in diameter and 6 cm. long, and held in place by turns from above downward. In early thrombophlebitis, the adhesive bandage is left on for three or four weeks, provided it does not become loose. This is followed by the wearing of elastic bandages and rubber stockings.

(Franz). Leo M. Zimmerman, M.D.

## ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

**Page, C. M.: Surgical Experiences with the B. E. F.** *Brit. M. J.*, 1940, 2: 731.

The rapid movements and quick change in events in France and Flanders during May and June of last year imposed a strain on the medical organization comparable to that to which the combatant section and other services were submitted. At the outset of the war the medical units and personnel were essentially the same as those which were operative at the end of the last war. In addition there were provisions for more mobile surgical teams for service in the casualty clearing area and the establishment of the Blood Transfusion Service.

The following outline represents an attempt to piece together the aims and achievements in handling the wounded man, and defines those aspects of the subject which appear to call for further trial and study.

*Wound prophylaxis.* Every wounded man received 3,000 units of anti-tetanic serum. Though the final figures are not yet available, the author knows of but 4 cases of tetanus in France. Anti-gas-gangrene serum (polyvalent) was available in quantities but was not systematically employed as a prophylactic. Sulfanilamide was also used in large quantities; it was given by mouth or as a wound pack. The dosage when given by mouth was generally 2 gm. followed by 1 gm. at four-hour intervals until a total of from 15 to 20 gm. was reached. In the wound pack, from 5 to 20 gm. were placed in the wound and kept in place by a suture or protective dressing. The general impression was that both streptococcal and anaerobic infection of wounds was definitely reduced by this action.

*Surgical treatment.* It is generally accepted that from 20 to 40 per cent of the reclining patients, and 5 per cent of those walking should be operated upon within twelve hours after being hit in order to achieve the best results. The importance of the treatment of primary and secondary wound shock before operation was fully recognized, and resuscitation teams, generally organized by an officer of the Blood Transfusion Service, were established both in casualty clearing stations and in base hospitals. Warmth, rest, and morphine had their place, but undoubtedly the provision and transfusion of stored blood was of key value. The general principle of wound excision (*épluchage* of French surgeons) determined the scope of the primary operation apart from the repair of any special viscus. The procedure was carried out whenever possible if the patient was received within from twelve to twenty-four hours after the injury. The excision should not involve the removal of much skin, but free incision is necessary to carry out the process effectively. Excision of devitalized fascia and muscle is of chief importance. In regard to primary suture after such operations, the general experience in France was against the practice.

The complications of a fracture or joint injury are also indications for surgery. On the other hand, through-and-through wounds due to rifle or machine-gun bullets are recognized as relatively benign from the point of view of infection. It was noted in France that this was the case, and such wounds were seldom excised if uncomplicated by serious hemorrhage or the perforation of a hollow organ.

In the event of a man's not coming under surgical care for two or three days after being wounded, formal wound excision is out of place. The treatment employed was to lay the wound freely open, remove the missile if possible, and excise necrotic muscle. Amputation was resorted to only in the more serious cases of gas infection.

The after-treatment both of wounds excised early and of wounds laid open on account of infection was to pack them with gauze sometimes soaked in vase-

line. When sulfanilamide was put into the wound the gauze pack was not employed. A course of sulfanilamide was also sometimes given by mouth to both groups of cases. The general practice was to avoid the redressing of wounds for four or five days unless the clinical signs suggested some progressive infection or the presence of secondary hemorrhage or gangrene. The closed plaster cast was not systematically used for wounds uncomplicated by fracture.

*Fractures.* The transportation of persons with fractures was carried out under accepted lines; the Thomas splint proved of great value both in transportation and in definitive treatment of fractures of the femur. Fractures of the tibia and fibula were generally placed in plaster casts, and in some of these cases transfixion pins were placed in the casts. Very few infections resulted from this practice. Fractures of the upper third of the humerus were bound to the side against an axillary pad. Fractures in the lower third were immobilized in plaster casts or in plaster slats. The Orr method of treatment was used with satisfactory results in fractures of both extremities.

Little opportunity occurred in France in May and June for the practice of the more deliberate type of surgery applied to the abdominal, head, and chest wounds. Certainly no advance was made on the experiences of the last war. JOHN W. EPTON, M.D.

**Cobet, R.: Evaluation and Treatment of Lung Injuries Caused by Firearms** (Beurteilung und Behandlung der Lungenschuesse). *Therap. d. Gegenw.*, 1940, 81: 241.

This work presents a review of the evaluation and treatment of pulmonary injuries due to firearms from the point of view of internal medicine, which is also interesting for the surgeon.

First of all, it is important to establish what organs have been damaged by the projectile. Peripheral nerves (brachial plexus) and the spinal cord, as well as the diaphragm and abdominal organs, may have been injured in addition to the lung. Death usually occurs on the battlefield in wounds of the heart, the large vessels, and the esophagus—in the latter cases, because nearly always some large vessel has been wounded at the same time. The total mortality of chest injuries by firearms amounts to about 40 per cent. The connecting line between the points of entry and exit of the projectile, under consideration of the posture of the body at the moment of the injury, gives a fair indication of the possibly damaged organs. Spent projectiles may inflict wounds with only a point of entry, occasionally with dropping of the projectile into the pleural cavity. Grazing of the lungs and secondary injuries by sharp fragments of bone may be caused by tangential shots.

Hemoptysis, hemothorax, pneumothorax, and emphysema of the skin are the main clinical signs of pulmonary injury. The freshly coughed up blood is bright red and foamy and becomes darker to a brownish cast in a few days; it is dark from the beginning in pulmonary contusion with hemorrhagic infarction. Late hemorrhage is principally caused by jagged grenade fragments and infectious erosion of vascular aneurysms. Hemothorax occurs nearly always in penetrating injury to the chest and remains absent only in case of pre-existing pleural adhesions. In general, the hemorrhages from the intercostal arteries or the internal mammary artery are more dangerous, while those of pulmonary wounds, because of the elasticity of the lung tissue, endanger life in exceptional cases only, for instance, when the tract of the projectile is kept expanded by pleural adhesions. The blood collecting in the pleural sac is diluted by an admixture of serous exudate and during the third week contains only about 1,000,000 red cells and from 1,000 to 10,000 white cells per c.mm., with a specific weight of from 1,023 to 1,026, in the case of sterile hemothorax. From the second to the third week, the number of the eosinophils increases occasionally up to 80 per cent of the total leucocytes, and shortly before resorption the lymphocytes preponderate. Numerous endothelial cells can also be demonstrated. The resorption of a hemothorax requires weeks. Usually, a rather extensive pleural scar remains. Pneumothorax is also generally observed in a pulmonary injury by a projectile. Small collections of air are rapidly absorbed. The valvular and the infectious tension pneumothorax may cause threatening symptoms. Open pneumothorax, whether primary or secondary, is dangerous on account of the possibility of mediastinal flutter and pleural infection. While interstitial emphysema of the skin in pulmonary injury is harmless, that of the mediastinum may cause severe symptoms and require surgical intervention.

Associated injuries of the abdominal organs or of the diaphragm are not rare in chest wounds by firearms. However, tension of the abdominal wall may occur as a result of irritation of the intercostal nerves in purely thoracic injury without participation of the abdominal cavity. Prolapse of the abdominal organs into the left thoracic cavity because of injury to the diaphragm may give rise to symptoms which simulate a tension pneumothorax. Damage to the kidney must be excluded by urine examination for blood. Firearm injuries to the chest or lungs, which are not infected, usually heal rapidly; the presence of fever is to be interpreted as a resorption symptom or must be attributed to slight pneumonia in the vicinity of the tract of the projectile through the lung.

The subsequent fate of the patient with a lung injury is decided by an infection of the pleural sac. Benign, serous pleurisy dilutes the usually present blood collection so that its specific weight is lower (about 1,019) than in simple hemothorax. The red cells are preserved and the lymphocytes preponderate in the moderate amount of white cells found. The punctate is mostly sterile and microscopic examination shows only individual phagocytized bacteria in the sediment. The course is benign and can be accelerated by puncture. Accompanying serous exudations, for instance, in subphrenic or thoracic

wall abscess, are also mostly benign, but their course depends wholly on the primary focus. Highly virulent or massive pleural infections rapidly cause severe disease pictures. The red cells are dissolved even in the case of bacteria which bacteriologically are are not designated as hemolytic. However, the punctate remains opaque on account of the preservation of the red-cell shadows, but a yellow, purulent precipitate appears in the place of the red cells when the punctate is centrifugated or permitted to stand. These signs allow recognition of a virulent pleural infection in hemothorax even without bacteriological examination.

Microscopic study reveals mostly neutrophil, polymorphonuclear leucocytes with a faded and often destroyed nuclear picture, and, in addition, the bacteria in varying but large numbers. This form frequently leads to death in from ten to fourteen days if it is impossible to overcome the infection and to reach the stage of early empyema. A hemothorax infected with putrefactive bacteria is rapidly decomposed with the development of gas, which may cause a secondary or infectious tension pneumothorax. The punctate is laky and evil smelling, and contains masses of bacteria of various kinds. However, gas-gangrene bacilli are only seldom found. Tension pneumothorax is generally prominent among the clinical phenomena. Usually, the course of the disease is rapidly fatal.

Infections of average severity, recognizable by their less stormy clinical picture, show, because of their slower hemolysis, a wine-red to dark brown effusion with copious, dirty yellowish brownish, centrifugated precipitate of leucocytes, red-cell forms, and rather numerous bacteria. However, a primary pleural infection may also develop independently from a hemothorax; it leads mostly to encapsulated empyema. A secondary infection from suppuration of the thoracic wall, pulmonary abscess, subphrenic abscess, or pneumonic infiltrate may penetrate into the thoracic cavity by sudden irruption of pus or by gradual migration of the bacteria. In the first case, the symptoms are stormy and threatening. The total empyema, which then often occurs, opposes reëxpansion of the lung in protracted suppuration, because of marked deposition of fibrin on the pulmonary surface and to the latter's induration. In addition to the numerous and not always unequivocal clinical signs, the result of the test puncture is of decisive significance for the recognition of empyema. The needle is to be introduced as near as possible to the upper limit of dullness at a site where no respiratory murmur can be heard.

The treatment of pulmonary injury by firearms should be mostly conservative and depends upon the requirements of the symptomatic picture. Transportation, even by airplane, is badly tolerated by the newly wounded and should not be attempted any earlier than fourteen days after the last hemoptysis. The care of the wound consists of cleansing and sterile dressing when an open pneumothorax, a tension pneumothorax, or a hemorrhage does not impose a surgical intervention. A piercing projectile is removed only when it can be reached easily, and even then mostly secondarily. A non-infected hemothorax is punctured only when it causes digestive disturbances; otherwise, it is treated conservatively. On the other hand, virulent infection of a hemothorax is actively attacked: repeated and adequate punctures are performed in an attempt to overcome the infection to the point where a still necessary rib resection can be deferred beyond the third week. Empyema, pulmonary abscess, and gangrene must be treated surgically.

(MASKE). RICHARD KEMEL, M.D.

**Andrewes, C. H.: The Control of Air-Borne Infection in Air-Raid Shelters and Elsewhere; Bacteriological Technique, Organisms in Coarse Droplets, Organisms in Droplet Nuclei, Bactericidal Mists, How and When to Spray, Organisms on Dust.** *Lancet*, 1940, 239: 770.

Air-borne infection may be conveyed: (1) in large droplet projectiles sprayed short distances from the mouth or nose; (2) in droplet nuclei which may float in the air for long periods; and (3) on dust.

Adequate spacing and ventilation are the most important counter-measures whatever the route of spread. Small and large-scale investigations have been made into the efficacy of other measures which may be applied when these are impracticable.

Spread by large droplets may be controlled: (1) by isolation of infected persons; (2) by screens between the heads of neighboring sleepers; and (3) by masks, of which one made of transparent cellulose acetate is comfortable, effective, and cheap, though unsuitable for wearing at night. Masks should be worn during the daytime by working people and occupants of shelters who have colds, and by all occupants of public places during influenza epidemics. In shelters those with coughs should wear a gauze mask at night.

Ultraviolet light is highly effective against organisms in droplet nuclei, but much less so against organisms on dust. Where forced ventilation is in use the issuing air can be rendered almost sterile by passing it through a cloth filter and between ultraviolet lamps. The cost of installation renders the general use of ultraviolet light impracticable in shelters at the moment.

Of several bactericidal mists effective against suspended organisms a mist of sodium hypochlorite is cheap, harmless in low concentration, almost odorless, and a powerful deodorant. Sodium hypochlorite corrodes metal, but suitable non-metallic sprayers, worked either electrically or by a foot-pump, are available. Small shelters should be sprayed before the occupants assemble, every half-hour before they settle down for the night, and again in the morning. In an epidemic, spraying may have to be repeated every half-hour during the night. It may be necessary to spray large shelters more or less continuously.

Dust on floors can be prevented from rising by treating the surface once a month with spindle oil

(crude liquid paraffin). Blankets can be prevented from dispersing their dust by soaking them in a 30 per cent solution of liquid paraffin in white spirit, and this will not make them feel oily.

The authors state that none of the methods for the control of respiratory disease which they have discussed is of proved efficacy in the field, though all of them have given encouraging results in the laboratory. However, there is justification in urging the use of methods of such unproved value because the means of controlling respiratory disease in the past have certainly been inadequate. The unprecedented conditions of life in a large part of Britain during this winter may be expected to swing the odds in the struggle between man and his respiratory pathogens still more heavily in favor of the bacterial forces. An ordered plan of defense is more necessary than ever before. The weapons of defense include the improvement of ventilation, masks, ultraviolet light, antiseptic mists, and the paraffining of floors and blankets. Which of these is best employed in any set of conditions is a tactical problem for the medical man in charge. In many instances it will be advisable and even necessary to combat simultaneously the three dangers of droplets, droplet nuclei, and dust.

SAMUEL H. KLEIN, M.D.

**Simon, R., and Patey, G. A.: War Tetanus, With Reference to 14 Cases Observed at the Centre Sanitaire Français of Besançon. The Action of Anesthetic Injections of the Sympathetics** (Le tétanos de guerre. [A propos de 14 cas observés au Centre Sanitaire Français de Besançon.] Action des infiltrations anesthésiques du sympathique). *Presse méd.*, Par., 1940, 48: 935.

The authors observed 15 cases of tetanus in a total of almost 1,900 wounded. Because of depletion these cases showed certain interesting imbalances of the sympathetic nervous system. Of their 15 cases only 1 had been regularly vaccinated with anatoxin, and this patient had an essentially benign and localized form of tetanus. Antitoxin had not been given or was given late in 12 of the 14 cases. It had been correct in 2 cases, and these 2 were cured after a short course of serotherapy.

The authors distinguish a hyperacute and an acute form of the disease. Of the former they had 2 cases, in both of which the patient died in thirty-six hours. Deep anesthesia was the only means of interrupting the state of constant tetanic spasm. Both patients had wounds in the scapular region and the incubation periods were less than a week. Four examples of the acute form are described. They were cases with incubation periods of from six to nine days; all of the patients had had amputations. They responded at first to treatment with serum and sedatives, but in a few days developed excruciating pain in the amputation stumps and again there were severe spasms which did not respond to the previous therapy. One of the patients died, but the 3 others responded to novocaine injection of the sympathetic ganglia supplying the limb in question. The dose in 1 case was 20 c.cm. of 10 per cent novocaine injected into the lumbar ganglia.

War tetanus, then, is different from civilian tetanus, in which the tetanus toxin plays the greatest part, in that major rôles are also played by the depleted state of the patient and by the painful stimulus of the extensive wound. Therapeutic procedures suggested by these facts are (1) the treatment of the tetanus intoxication, and (2) the avoidance or attenuation of the irritative action of the wound or amputation stump.

The treatment of the tetanus intoxication was carried out along accepted lines as follows:

Serotherapy was given to the extent of from 80,000 to 120,000 units a day for the first few days and then the amount was diminished. In the serious forms almost 1,000,000 units have been injected by the subcutaneous or intramuscular route. The intraspinal route is not used. Serum sickness occurred in only 2 of the 14 cases. The sedatives and anesthetics used were chloroform, chloral, and avertin. Sulfanilamide was used in large doses in 1 case without obvious beneficial effect. General anesthesia with chloroform was used for half-hour periods as often as three times a day. The excessive use of hypnotic drugs is usually ineffective and may cause severe neurological symptoms such as decerebration. The treatment of the peripheral irritation factor is best carried out, as described, by novocaine block of the sympathetic supply of the area. Infiltration of the regional nerves does not have the same effect.

RICHARD WARREN, M.D.

## ANESTHESIA

**Brown, W. E., and Lucas, G. H. W.: Further Studies with Ethyl Normal Propyl Ether.** *Canadian M. Ass. J.*, 1940, 43: 526.

From work reported one year ago by Brown on the anesthetic properties of ethyl normal propyl ether it was believed that it was a safe anesthetic and might be used on the human subject without ill effect.

Proceeding cautiously in the first of a series of human anesthesias, ethyl normal propyl ether was used to reinforce nitrous-oxide-oxygen mixtures in approximately 50 anesthesias for various operative procedures, the nature of which did not require any particular degree of relaxation, the patients being carried in the light phases of the third degree of anesthesia. The series included such procedures as dilatation and curettage, amputation of the hand, the treatment of hydrocele, litholapaxy, suprapubic prostatectomy, the treatment of a lump in the breast, and similar types of operations.

A follow-up made of all the cases showed rapid awakening, comparable to nitrous-oxide-oxygen alone. Slight vomiting occurred with awakening in 7 per cent of the cases; during the following twelve hours, 11 per cent had some vomiting; after this time 2 per cent still had vomiting. An appreciable fall in the blood pressure was noted in 4 per cent of the cases.

A comparative analysis of the anesthetic effects of diethyl ether and ethyl normal propyl ether was made with the closed system method of Kruse. Observations on a limited number of cats were made. From these experiments the following conclusions may be drawn:

Ethyl normal propyl ether is from one and a half times to twice as potent an anesthetic as ethyl ether. Respiration was definitely depressed by the ethyl normal propyl ether in some 4 to 5 per cent concentrations, and by ethyl ether in some 6 to 8 per cent concentrations. Respiration was more depressed in deep surgical anesthesia with ethyl normal propyl ether than with ethyl ether. Light surgical anesthesia with from 2.5 to 3 per cent of propyl ethyl and from 3.5 to 5 per cent ethyl ether was obtained under comparable conditions. The blood pressure did not fall seriously even when the respiration was dangerously slow and shallow, and fell only to about 100 mm. when the respiration failed. Artificial insufflation was always successful in the resuscitation of these failures.

The explosibility of nitrous oxide, oxygen, and normal propyl ethyl ether mixtures was tested with a portable apparatus. Analysis showed that more than 2 per cent of the propyl ether had to be present to produce an explosion. Propyl ether explosions seemed less forceful than those of ethyl ether. Samples taken during light third-stage anesthesia showed concentrations of ethyl propyl ether of 1.5, 1.9, 1.8, and 1.7 per cent, or just under the explosive concentration.

JOHN E. KIRKPATRICK, M.D.

**Waters, R. M.: Anoxia; The Anesthetist's Point of View.** *J. Am. M. Ass.*, 1940, 115: 1687.

It is important to realize that disturbance of the oxygen supply to the central nervous system is one of the most common deleterious effects of anesthesia.

The anesthetist does well to look upon the physiological mechanisms involved in the delivery of oxygen to the tissues of the body as a simple transport system.

Depression of, and obstruction to respiratory exchange, are common sequelæ of anesthesia and pain therapy. Intelligent management, for example, the use of artificial airways and the manual or mechanical increase of tidal exchange to prevent disturbance of the oxygen transport and to restore normal transport when possible is a necessary corollary to drug administration.

Forewarned is forearmed. The integrity of the patient's oxygen-transport mechanism should be investigated before pain-relieving drugs are given.

Oxygen therapy (high oxygen tension in the inspired atmosphere) is only one way of treating oxygen want in the tissues. Accurate diagnosis will often point the way to the restoration of normal transport of oxygen, and thereby eliminate the necessity for oxygen therapy. Oxygen under adequate pressure should be administered to avoid an oxygen deficit, but one should not be lulled into inaction so that one neglects diagnosis, and any treatment which may restore a normal transport mechanism for distribution of oxygen to the cells of the body.

ANTHONY F. SAVA, M.D.

# PHYSICOCHEMICAL METHODS IN SURGERY

## ROENTGENOLOGY

**Westermark, N.: Tuberculosis of the Bronchial Lymph Glands. A Roentgenological Investigation.** *Acta radiol.*, 1940, 21: 399, 423.

The author briefly reviews the literature relating to roentgenological investigations of morbid changes in the pulmonary hilum and calls attention to the frequent misinterpretations and diagnostic errors made on findings observed there. He believes these to be due to indistinct definitions of what constitutes normal hilum images and to the lack of knowledge of the anatomical structures producing them. With a view toward clarifying some of the difficulties, he presents anatomical studies of the pulmonary hilum, pulmonary vessels, and lymphatic system of the lung, and the anatomical basis of the roentgenological appearance of the hilum and lungs. Roentgen technique and interpretations of shadows revealed by exposures in various directions are discussed and illustrated at some length. The localization and distribution of primary tuberculous processes in the lungs and appertinent lymphatic systems as studied by other workers in connection with post-mortem observations and calcified foci revealed roentgenologically are described. The author's own roentgenological investigations into the closer relationship of these conditions are presented in detail with numerous diagrammatic illustrations.

Pathological changes occurring with tuberculosis of the hilum lymph nodes are given brief consideration as an introduction to the roentgen findings which they produce. The extent and stage of development of the disease and possible complications, both of the primary focus in the lungs and of the associated lesions in the appertinent lymphatic systems, determine the roentgenological findings of diagnostic value. The primary focus may be so slight as to produce no demonstrable roentgen changes. It may present as a more or less rounded shadow in the parenchyma with a variable amount of surrounding perifocal infiltration or obstructive atelectasis. In the presence of an acute primary focus in the lung, the regional lymph gland corresponding to the location of the focus is always found to be the seat of changes. These changes may extend secondarily to other connected lymph nodes. In the presence of tuberculosis merely of the bronchial lymph nodes without any visible primary focus, the glandular changes are often bilateral although more pronounced on one side than the other. Pyocaseous hilar adenitis appears in the roentgenogram as larger or smaller confluent glandular masses in which it is impossible to define the individual lymph nodes or groups of nodes from one another. Because calcium phosphate is formed in the caseous lymph nodes, these become denser than the surrounding tissues in the mediastinum. They thus appear in the roentgenogram not only by virtue of their increased size but also because of their added density.

Various changes due to displacement or compression of the adjacent bronchi or blood vessels are also described and illustrated. Attention is called to the value of the Valsalva experiment and of iodized-oil injections in determining the nature of some of the findings observed.

As regards differential diagnosis, it is only when the lymph nodes have reached such a size as to be directly or indirectly observed that it becomes possible to make a roentgen diagnosis at variance with the normal. Such enlargements may be due to causes other than tuberculosis, among which bronchopneumonia, bronchial carcinoma, benign and malignant lymphogranuloma, and leucemic or pseudoleucemic lymph adenosis are given consideration and points of differentiation mentioned.

A comparative study of the roentgenological and bacillary findings in 365 tuberculin-positive children showed very good correlation between such findings. Detailed data of these cases are included. The author concludes that a careful roentgen examination permits of ascertaining the presence, nature, and extent of the process with considerable accuracy.

ADOLPH HARTUNG, M.D.

**Keys, A., Friedell, H. L., Garland, L. H., Madrazo, M. F., and Rigler, L. G.: The Roentgen Kymographic Evaluation of the Size and Function of the Heart.** *Am. J. Roentgenol.*, 1940, 44: 805.

This article is such an exhaustive review of the subject as to warrant the recommendation that it be read in the original by anyone who is interested in kymography.

Planimetric measurement of the area of the postero-anterior projection of the roentgen image of the heart has been repeatedly shown to be the best single measurement for estimating the true size of the heart. It would seem reasonable, therefore, to make such measurements on a kymogram, and thus eliminate the uncertainty of the phase of the cardiac cycle. If the kymogram is used, the planimetric measurements can be made for both systole and diastole, which makes possible the determination of the stroke output.

Extensive studies were made of more than 700 subjects, including normal individuals, athletes, and persons with cardiac disease. The methods used to estimate systolic and diastolic frontal areas are discussed in detail. Simultaneous kymographic and acetylene-rebreathing experiments were carried out to determine the accuracy of the kymographic method. A satisfactorily constant relation was found, and equations were determined. The factors required for the different methods are discussed in detail. The alteration of the stroke output by drugs,

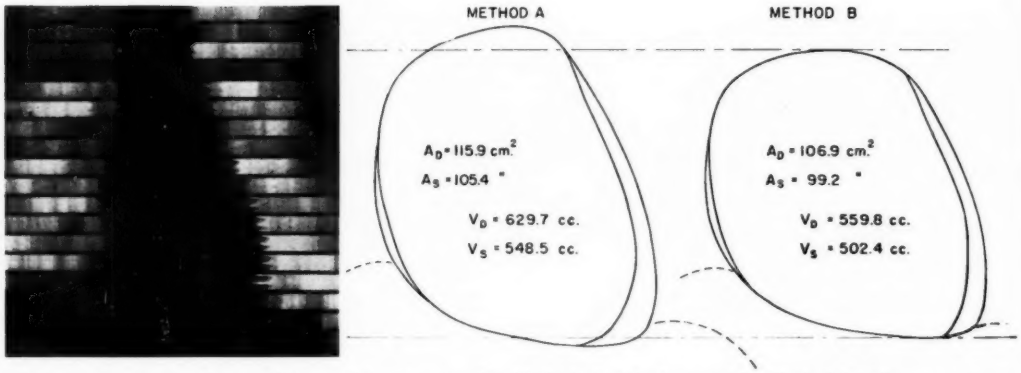



Fig. 1. Kymogram of an athlete, aged twenty-one. By Method *A*, $\Delta V = 81.2$, and by Method *B*, $\Delta V = 57.4$ c.cm. The ratio $\Delta V_A / \Delta V_B = 1.41$.

the phase of respiration, and cardiac disease have been studied.

Tables of factors are given to facilitate practical application of the methods described.

Figure 1 illustrates a kymogram, and the results of two methods used to evaluate the planimetric measurement of the area of the heart. The area and volume have been determined for systole and for diastole. The volume stroke output is obtained by subtracting the volume in systole from the volume in diastole. HAROLD C. OCHSNER, M.D.

**Hultén, O.: The Value of Roentgen Diagnosis in Acute Abdominal Diseases** (Ueber den Nutzen von Roentgendiagnostik bei akuten Bauchfaellen). *Acta radiol.*, 1940, 21: 471.

The purpose of this address is to emphasize the value of combining the surgeon's and roentgenologist's diagnostic studies of acute abdominal abnormalities. On account of the urgency the presence of both the surgeon and the roentgenologist is of utmost importance while the pictures are taken and decisions which will be most advantageous to the emergency therapy are made. To get the best results, the roentgenologist should be given all cases of acute abdominal disturbance coming into the hospital for study, as it requires much experience to get reliable pictures and to give correct interpretations. Exploratory laparotomies are less numerous as the result of these studies. In Uppsala they have records of thousands of such roentgen pictures—a record not equalled elsewhere. The closest coöperation of the roentgenologist with the surgeon, as well as with the interested hospital staff, is often necessary for the evaluation of negative pictures in order to formulate correct therapeutic deductions. Too much attention cannot be given to this study.

The roentgenograms are of great importance for the following:

In locating unusual appendical positions, especially in children.

For the localization of residual abscesses in diffuse peritonitis complicating appendicitis.

Diagnosis of subphrenic abscesses, gastric ulcers, and perforations.

Diagnosis of pylephlebitis, as well as of hepatic abscesses.

For differential diagnosis between disease of the right uterine adnexa and appendicitis; this often is difficult as even right ovarian cysts may be mistaken for appendical masses.

In ureteral calculi versus appendicitis, urography will be decisive.

The different types of ileus can be distinguished roentgenologically from one to two hours after their onset. From ½ to 1 oz. of barium may be safely given orally to facilitate the study at the very beginning of the symptoms; thus the condition can be recognized almost at once. Hultén believes that barium in small quantities is permissible in nearly all abdominal abnormalities.

Volvulus of the sigmoid flexure and of the cecum, as well as ileocecal invaginations, is easily seen; these conditions are often corrected therapeutically by such examinations, especially if small quantities of barium are given orally.

Acute pancreatic affections are often diagnosed on the basis of the changes surrounding the pancreas. However, these contiguous changes cannot always be definitely accepted as diagnostic, as other abnormalities which produce similar pictures may be involved. Duodenal enlargement and paresis may be noticed in acute pancreatitis; according to the author the so-called paralytic duodenal ileus is of great importance in the clinical picture of this disease.

In the perforation of gall stones into the duodenum, and in perinephritic and traumatic injuries of the abdomen, roentgen examinations are often diagnostic.

In cases of extreme prostration, the attendants, naturally, must be very cautious to safeguard the strength of the patient, avoid rough handling, and

not in any manner unduly expose the patient to further injury.

If the roentgen findings are negative, the surgeon should nevertheless proceed as per indications, but with caution. MATHIAS J. SEIFERT, M.D.

**Wangensteen, O. H.: The Value of Diagnostic Criteria for the Choice of Therapeutic Procedure in the Management of Acute Intestinal Obstruction; Experimental and Clinical Observations.** *Radiology*, 1940, 35: 680.

In the proper interpretation of the significance of intestinal distention, the roentgen findings afford such helpful assistance, that this source of factual information must never be neglected by the clinician. The findings play an important rôle in the choice of therapeutic procedures in the management by helping to determine whether obstruction is present, where the obstruction is located, and whether it is partial or complete.

The value of the roentgen findings is based largely upon the location of the gas-distended loops of gut and recognition of characteristics which permit of differentiation between the intestines involved. Whereas in the infant and the young child, gas may be visualized quite regularly throughout the entire length of the bowel, in the adult, visualization of gas in the small bowel is distinctly unusual and signifies intestinal stasis. It is understood now quite generally that the chief source of gas in the obstructed bowel is swallowed air. The extent of bowel distention as revealed by the roentgen examination is a fairly reliable factor of the grade of obstruction. Persistence of gas in the colon after the administration of evacuant enemas in the presence of dilated loops of small intestines suggests the pressure of a partial obstruction in which gas has filtered past the obstructive mechanism.

As regards the technique of the examination, plain or scout films made in the anteroposterior, posteroanterior, or specially indicated positions with the patient reclining may give the desired information. In obstructions of longer standing, in which fluid accumulation within the gut may, in part, obscure the extent of the distention, films made in the sitting or erect posture will indicate more exactly, by the fluid levels or mirrors, the character and extent of the distention present. In all borderline acute conditions of the abdomen, the erect film should always be made to determine the absence or presence of free gas in the peritoneum. Similarly, when the gut has ruptured in obstruction from long sustained increases in intraluminal pressure, an erect film detects the occurrence, although visualization of the external surface of the gut made in the anteroposterior film suggests the same occurrence. Occasionally, the lateral or oblique views give helpful information in determining in which segments of gut the distention has occurred. It is rarely necessary to administer barium to determine the site of the obstruction. In instances in which the feathery appearance of the valvulæ conniventes cannot with certainty be differentiated from the haustrations of the colon, and the clinical information is noncommittal, it may be wise to give a little barium by rectum to aid in the differentiation. The characterless wall of the ileum can usually be distinguished with ease from both the dilated jejunum and colon.

In exceptional instances unusual positions may be indicated. An inverted or upside down position may give valuable information as to the location or extent of the lesion in cases of congenital atresia of the anus or rectum.

Although roentgen findings occasionally are sufficiently characteristic to be diagnostic they may be misleading, and intimate correlation of roentgen and clinical evidence is usually indicated for accurate interpretation.

Among the benefits to be derived from the preliminary roentgen examination combined with clinical observations, the chief one is the frequent ability to separate cases which can be treated successfully without recourse to operative intervention from those in which prompt operation is imperative. The effects of decompression by conservative means may also be followed by repeated roentgen observations and the absence of favorable results may suggest the need for other methods of treatment.

ADOLPH HARTUNG, M.D.

**Steinert, R.: The Roentgen Picture of Rectal Narrowing in Lymphopathia Venerea** (Die Rectumverengerung bei Lymphopathia venerea und ihr roentgenologisches Bild). *Acta radiol.*, 1940, 21: 368.

It is amazing that the roentgen findings showing the characteristic picture of rectal narrowing in lymphopathia venerea are so seldom mentioned in the literature. The reasons are that this disease is relatively little known to date, only a few cases having been reported, and, above all, it belongs to the domain of venereology and surgery.

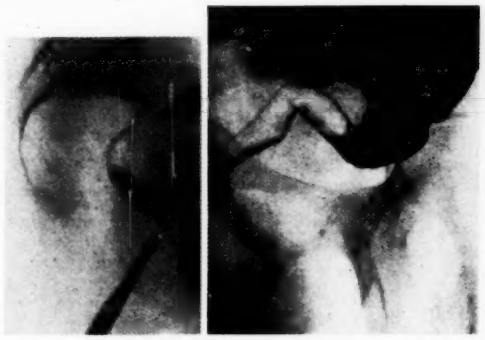


Fig. 1. Left, The large distance between the os sacrum and the rectum.

Fig. 2. The threadlike part of the rectal narrowing of the same case after it was cautiously inflated.

It usually begins with a mild herpetiform desquamation of the skin from one to three weeks after coitus. One to two weeks later strumous bubos, from the size of a nut to that of a chicken egg, appear in the groins. They rupture and leave characteristic scars. This may also occur independently of coitus; it is caused by a virus that can be cultured and readily demonstrated. The sickness may disappear spontaneously without bubo formation and leave no scars.

On the basis of Frei's reaction lymphopathia venerea is identical with the tropical bubo. It is assumed that sailors infected in the tropics brought the infection to Scandinavia. It is now more prevalent in Europe than before the World War. In addition to the local symptoms, meningeal complications, pyrexia, hepatic disturbances, exanthems, protracted joint diseases, oral and laryngeal involvements, and late narrowing of the rectum may occur. Syphilis and various other etiological factors were named as the cause of this disease, but Frei in 1928 could prove that patients with benign rectal narrowing reacted positively to his antigen. Jersild claims elephantiasis genito-anorectalis occurs in this disease principally in men and that rectal narrowing is more common in women. Jersild stated that 80 per cent of all the rectal narrowing occurs in women, and that this is due to the fact that infection takes place in the posterior vaginal wall at the posterior commissure, perineum, and anus, from which location the lymph channels lead directly to Gerota's glands which lie in the rectal wall about 5 cm. from the anus. The infections in the male occur in the penis whence the lymphatics lead laterally into the inguinal glands and do not receive any lymph from the perineum nor from the cutaneous part of the anus. Most men afflicted with this disease were supposedly passive pederasts. The theory of lymph stasis in the glandular system gave way to the theory of lymphangitis as a cause of this sickness. Steinert reported 7 patients with rectal narrowing, 5 women and 2 men, all of whom reacted positively to the Frei antigen test. One patient was encountered at the Kommunale Krankenhaus in Kristiansand, 5 in the Krankenhaus Ullevål, and 1 in Reich's Hospital, Oslo.

All of these patients had several symptoms in common: a very slowly progressing clinical history of disease with, at times, painful defecation, bloody, purulent and mucous discharges, pruritus, tenesmus, intermittent constipation, and then acute obstruction. The general condition of these patients was often complicated with other diseases. They were wasted, haggard, anemic, feverish, and greatly depressed. All these symptoms showed that lymphopathia venerea is very dangerous to life. Most of the patients die before they are fifty years old. The nontreated patients die and others must submit to colostomy or other painful procedures.

The roentgen rays also show many common traits of the disease: the rectum appears as a more or less rigid tube with necrotic or unravelling walls from which fistulous passages extend into blind pouches or abscessed pockets. The usual ampullar widening of the rectum is absent, and its elasticity is lost or greatly reduced. The great distance between the rectum and the os sacrum is very remarkable and a characteristic feature of this disease.

Lues, gonorrhea, and even tuberculosis are frequent complications that sometimes lead to a false diagnosis. Cancer cannot easily be mistaken for lymphopathia venerea. When the diagnosis is uncertain the roentgen study should be followed by the Frei test. The abnormally widened space between the rectum and the os sacrum is a characteristic feature of the disease—but not only an anteroposterior but also a lateral exposure should be made.

MATHIAS J. SEIFERT, M.D.

**Barbieri, A.: Roentgen Investigation of Ureterocele** (L' indagine radiologica nell' ureterocele). *Radiol. med.*, 1940, 27: 687.

Most authors think that ureterocele is congenital, or rather that the conditions favoring the development of the anomaly are congenital. Ureterocele has been reported with equal frequency in the two sexes and at all ages; it is usually unilateral, but may be bilateral in rare cases. The lumen of the ureterocele may be occupied by urine, products of exudation, or calculi. The first roentgen picture of ureterocele was described by Lenarduzzi: it was complete and is still the only one which can be relied upon with security for the recognition of the defect. Descending urography is the only method that is capable of giving all the necessary data to make the roentgen diagnosis; however, there are some conditions under which the dilatation cannot be demonstrated even by means of this method: for instance, when the ureterocele is filled with thick pus or is occupied by a roentgen transparent calculus, when the corresponding kidney does not eliminate opaque urine, or when the proximal urinary tract is enormously dilated (hydronephrosis) and the opaque urine is therefore diluted by such a large quantity of fluid that it becomes roentgenologically unrecognizable. Evidently, the technical rules for the execution of accurate descending urography must be strictly observed and numerous films must be taken during the various phases of the elimination of opaque urine in order to catch the picture of the lower part of the ureter in its various filling and emptying aspects.

Barbieri describes his observations in 4 cases. The first case, in a child aged five years, is interesting because it supports the theory of the congenital origin of ureterocele. The roentgen picture showed at the left ureteral opening a narrow, roundish filling defect, in the center of which was projected the image of the terminal extremity of the ureter which showed signs of dilatation; the right ureter presented only a slight incomplete halo, which was difficult to interpret because of the presence of gas in the adjacent parts (Fig. 1). The second case, in a man aged twenty-four years, presented a bilateral ureterocele with calculi on both sides. The third case, in a man

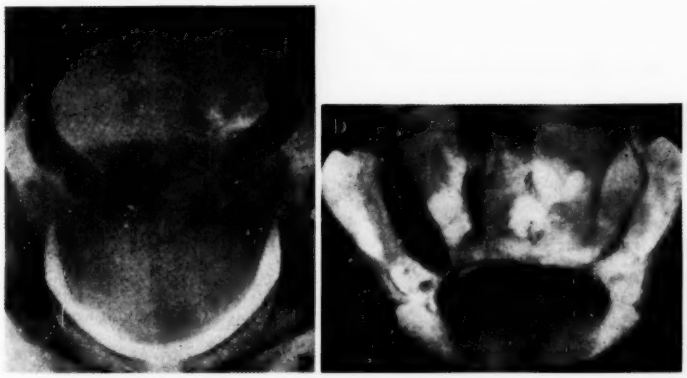


Figure 1. Left, First case. Indication of bilateral ureterocele.
Figure 2. Third case. Large unilateral ureterocele; second phase of elimination of opaque urine.

aged thirty-five years, was distinguished by one of the largest unilateral ureteroceles described up till now (Fig. 2): the cavity was free of foreign substances so that it filled completely with opaque urine. The fourth case, in a child aged two years, showed a slight dilatation of the lower extremity of the left ureter surrounded by a narrow, transparent halo; this could have been a ureterocele. The marked nearness of the two ureteral orifices in the second case and the presence of other anomalies in the third case (bifid renal pelvis and anomaly of the lumbar spine) also support the theory of congenital origin of ureteroceles.

The roentgen signs of ureterocele in the order of their importance are: (1) the appearance at the site of the ureter of an opaque intravesical spot, surrounded by a narrow, transparent halo with clear limits and in the form of a circle, or with an interruption in its upper lateral portion (picture of Lenarduzzi); (2) the appearance of a transparent halo, with clear limits and in the form of a U embracing the lower extremity of a ureter which is uniformly dilated and protrudes into the vesical cavity; (3) the appearance at the site of the ureter of a roundish, intravesical filling defect (sign of Rossoni and Wuellenweber), eventually of varying volume (sign of Mingazzini); (4) the appearance at the site of the ureter of a grossly hemispheric filling defect (sign of Turano); and (5) the appearance of a transparent halo, with clear limits, around the shadow of an intravesical roentgen opaque calculus (sign of Åkerlund). The first or the second picture allows making the diagnosis of ureterocele with certainty; the other signs must be confirmed by cystoscopic examination.

During the past year, the author has discovered 4 ureteroceles in 206 descending pyelographies and 7 ureteroceles in 246 cystoscopies; but 3 of the latter 7 cases had not been submitted to roentgen examination. The practical value of roentgenography and of cystoscopy for the diagnosis of ureterocele is consequently about the same, but each of the two examinations has its own particular indications. The success of the first depends on the accuracy of the technique and on the renal function, and that of the second on the local anatomical conditions, especially those of the vesical mucosa. RICHARD KEMEL, M.D.

**Hill, H. A., and Sachs, M.D.: The Grooved Defect of the Humeral Head; A Frequently Unrecognized Complication of Dislocations of the Shoulder Joint.** *Radiology*, 1940, 35: 690.

The fact that available sources of information had failed to disclose the origin of a large deficit or groove in the posterolateral aspect of the head of the humerus which is noted on roentgenograms of traumatized shoulders induced the authors to make a detailed study of the literature and of 119 cases of dislocated shoulder reviewed by them. This led to a clarification of their original conceptions regarding the nature of this lesion and identified it not as a late result of dislocation, but as a true fracture.

The literature relating to shoulder dislocations is reviewed briefly and a "typical defect" mentioned by various observers in connection with resected heads is summed up in the following description: the defect is located posteriorly and medially to the greater tuberosity on the posterolateral aspect of the articulating surface of the humeral head. The groove is navicular or wedge-shaped and its average measurements are 2.5 cm. in length (cephalocaudad), 1.5 cm. in width, and 0.75 cm. in depth. The defect is demarcated from the surrounding normal bone by sharp or vertically projecting walls, which in the larger defects stand at right-angles to each other. The spongiosa bordering the defect is thicker than elsewhere and is covered with a glossy, smooth layer of connective tissue. No fragment avulsed from the humerus is to be seen.

Since more conservative methods have displaced resection as a method of treatment for habitual

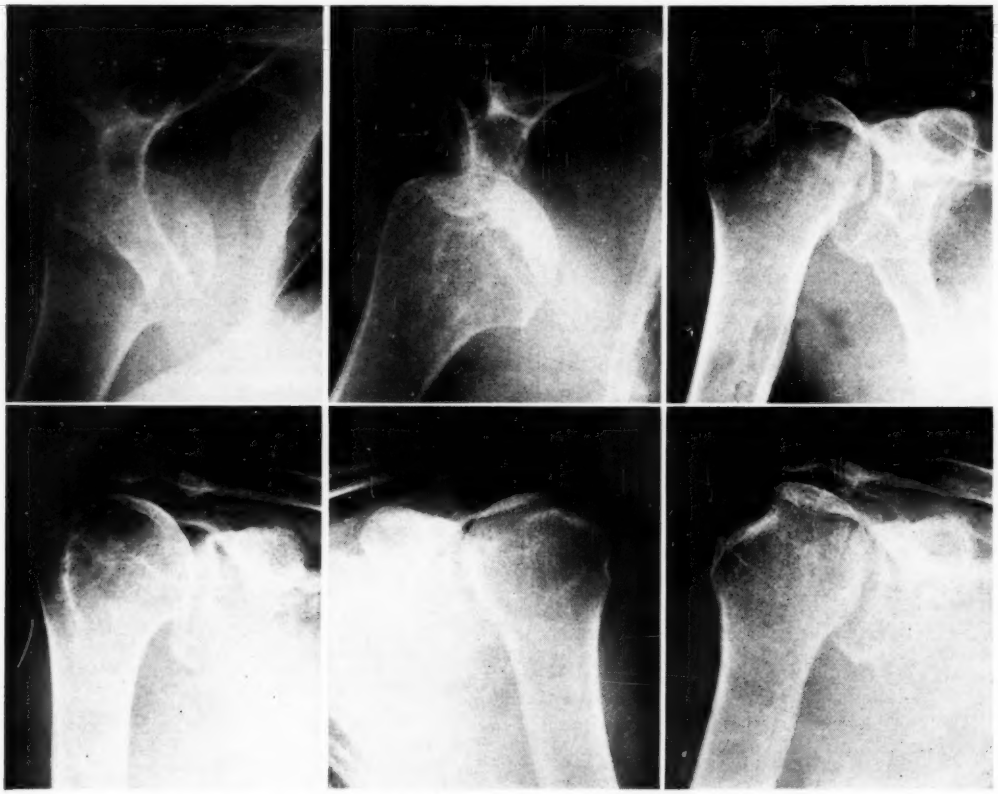


Fig. 1. Upper left, Nov. 8, 1937. Subcoracoid dislocation of the right humerus; view in external rotation shows no groove. upper center, June 27, 1938. X-ray made following re-dislocation, with the humerus rotated slightly externally reveals a slight flattening of the superior-lateral contour of the head. upper right, Sept. 22, 1938. Following correction of the third dislocation, a large groove is visible when the humerus is in marked internal rotation. lower left, Oct. 11, 1938. The right humerus in external rotation, routine projection, showing no visible defect. lower center, Oct. 11, 1938. The left humerus in internal rotation for comparison with the right; no groove present. lower right, Oct. 11, 1938. The right humerus in marked internal rotation; this projection clearly reveals the large defect which was "hidden" in the routine view. (This case presented through the courtesy of J. Minton Meherin, M.D.)

shoulder dislocations, the defect is frequently not discovered at operation, but roentgen studies, if properly made, will reveal it. The mechanism involved in producing it and the technique necessary to demonstrate it are described in detail. An anteroposterior projection made with the arm in marked internal rotation is essential, and in a small percentage of cases the defect will be disclosed only by means of a tangential view of the posterolateral aspect of the humeral head. In this position the defect is revealed as a compression fracture having the following roentgen characteristics:

1. Flattening of the contour of the articular surface or, in larger defects, an indentation, excavation, or groove on a level with the greater tuberosity

2. A sharp, dense line running downward from the top of the humeral head, parallel to the axis of the shaft and somewhat lateral to the mid-line (This "line of condensation" is a special sign, and is the result of the compression or compaction into a narrow medial border of the spongy bone previously occupying the space of the defect.)

3. The floor of the defect (best seen in the tangential view) showing a dense compacted border

A number of detailed case reports with illustrative roentgenograms are included and the findings in connection with the 119 cases studied are tabulated. The authors believe that recognition of the compression-fracture defect, in addition to its obvious medicolegal importance, should lead to better results in,

the treatment of shoulder dislocations and disabilities. ADOLPH HARTUNG, M.D.

**Baastrup, C. I.: The Diagnosis and Roentgen Treatment of Certain Forms of Lumbago.** *Acta radiol.*, 1940, 21: 151.

The disease called spinous-process lumbago by the author is described. Pressure of the lumbar and first sacral spinous processes on each other causes injury to the interspinous soft tissues and the development of pathological conditions, which may or may not be visible roentgenologically. Strong pressure may be caused by several factors, namely, increased lumbar lordosis, increased volume of the spinous processes, shrinking of the vertebral bodies and intervertebral discs, and spondylosis deformans. Rapid movement or effort may produce an acute interspinous lesion.

The most frequent direct causes of pain are tension in hematomas, reactive edema, and perhaps some irritative process in the periosteum or ligaments. Protracted muscle contraction is the most common secondary cause. These factors cannot be demonstrated roentgenographically. Osseous changes are probably a direct cause of pain to a much lesser extent. This may explain why there may be no pain with extensive osseous changes, whereas pain may be severe with no demonstrable x-ray lesions. Evidence that the seat of this lumbago lies in the interspinous tissues rather than in the muscles themselves is presented. In spinous-process lumbago an injection of novocaine between the processes would often stop an acute or chronic attack, whereas injection of the contracted painful muscles would not.

The treatment of acute spinous-process lumbago is the same as that employed in ordinary acute backache, namely, heat, rest, and analgesics. In chronic cases physical therapy should be tried, and if ineffective, roentgen therapy should be instituted. The results of roentgen treatment of 43 cases of chronic lumbago are reported. In most cases three doses of 300 roentgens were given at intervals of six weeks. Of a total of 16 men, 12 showed improvement, and of a total of 27 women, 21 showed improvement. The effect of radiation is analgesic, not curative. Due regard is given to the uncertainties involved in evaluating back pain and its relief.

JOHN L. LINDQUIST, M.D.

**Deucher, W. G.: Myeloscopic and Myelographic Observations in Prolapse of the Posterior Portion of the Intervertebral Disc Causing Sciatica** (Myeloskopische und myelographische Befunde bei Bandscheibenprolapsen). *Acta radiol.*, 1940, 21: 164.

Deucher discusses the symptoms of prolapse of the posterior portion of the intervertebral disc, which occur usually in the lower extremities, and insists on the importance of the anamnesis. The cerebrospinal fluid should be examined in all suspected cases: an increase in the total albumin content above 40 mgm. per 100 c.cm. is often found. A lateral roentgen exposure is also indicated: although it does not allow

Fig. 1. Unilateral prolapse of intervertebral disc $L_{2-3}$. Exposure in abdominal position of the patient.

the making of the diagnosis of prolapse, it may reveal other processes of the vertebræ which compress the dural sac, and it has some diagnostic significance if it shows a unilateral decrease in height of the intervertebral disc corresponding to the side on which the symptoms are most marked, and at the correct level. When prolapse is suspected, the diagnosis can be cleared up and the exact site of the process established only by myelography.

Five cubic centimeters of lipiodol are injected into the subarachnoid space through a lumbar puncture, and the patient is examined in abdominal position on a table that can be tilted to an angle of 45 degrees to the horizon. If a defect is discovered, the examination is repeated in the oblique abdominal and in the lateral positions and then in dorsal decubitus. As a rule, the prolapse can be recognized only in the abdominal and in the oblique abdominal positions and is found in most cases in the lumbar region. It appears as an extradural tumor under the form of a rounded defect which protrudes like a tooth into the lipiodol shadow of the subarachnoid sac and strongly reduces the width of the shadow at this level. The defect is sharply delimited in all directions and is unilateral in most cases, although it may pass the middle line; it corresponds to an intervertebral disc and has about the same height, but its base is often

wider, because of the fact that the dura bridges the sharp angle present between the prolapse and the neighboring border of the vertebral body (Fig. 1). In addition, the roentgenogram often shows the edematous swelling of an efferent nerve by a broadening of the negative shadow of its root. A defect in the lipiodol column is significant only when it is constant.

Three cases of prolapse diagnosed at the Department of Roentgenology of the University of Zurich are reported: all were operated upon successfully by laminectomy and removal of the prolapsed part of the disc. RICHARD KEMEL, M.D.

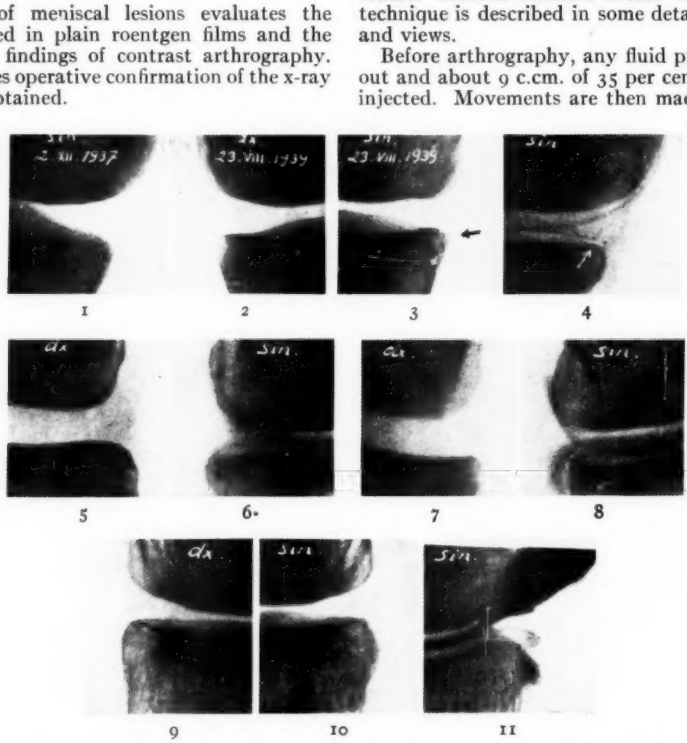
**Lindblom, K.: Roentgenographic Evidence of Meniscal Lesions in the Knee Joint.** *Acta radiol.*, 1940, 21: 274.

This study of meniscal lesions evaluates the changes observed in plain roentgen films and the more definitive findings of contrast arthrography. In most instances operative confirmation of the x-ray diagnosis was obtained.

For contrast studies of the knee joint the use of iodized oils and thorotrast are justifiably condemned. If, on the other hand, water-soluble iodic salts are used in a non-irritating or only slightly irritating form, Lindblom makes no more objection than to the use of air or oxygen. The salts have an advantage in that they mix with the fluid left in the joint. The addition of a gas after the injection of a positive medium makes judgment more difficult.

The author believes, in contrast to Schaer, that there is a high frequency of roentgenological signs of local arthrosis in cases of meniscal lesions and that the arthrosis is probably secondary to the meniscal lesion. His material consists of 75 cases in which arthrography was done, and 156 cases plus the same 75 cases in which direct roentgen studies without contrast media were made. The technique is described in some detail as to position and views.

Before arthrography, any fluid present is pressed out and about 9 c.cm. of 35 per cent perabrodil are injected. Movements are then made to spread the




Figs. 1–4. Roentgenograms and arthrogram showing development of bony changes in a case of meniscal lesion. Figs. 1 and 3 show the medial part of left knee one month after injury and one and one-half years later; arrow marks oeteophyte. Fig. 4 represents the arthrogram of left knee before operation; arrow marks fissure in the posteromedial portion of medial meniscus.

Figs. 5–8. Roentgenograms and arthrograms of 2 cases of inveterate meniscal lesions showing arthrosis of injured knee (arthrogram) and normal conditions in the other knee (roentgenogram).

Figs. 9–11. Roentgenograms and arthrogram of a case four weeks after injury of left knee. Compare appearance of right and left tibial condyle (Figs. 9 and 10). Fig. 11 illustrates a fissure in the anteromedial portion of medial meniscus.

medium, and a compression bandage is applied over the suprapatellar recess. Roentgen examination is made as quickly as possible because of the rapid resorption of the medium. No complications arose other than a slight, dull ache in isolated cases during the first half-hour after injection or a little exudate in the first twenty-four hours.

The arthrographic evidence of a meniscal lesion was: (1) contrast filling of a fissure (35 cases); (2) partial defect of the meniscus (10 cases); (3) interposition of the pathological soft tissues between the condyles (2 cases); and (4) a combination of findings (4 cases). A significant observation was that most fissures of the medial meniscus seemed to originate from the inferior surface, which should be carefully examined at operation. For the purpose of diagnosis the finding of a fissure has greater significance than the appearance either of a partial meniscal defect or of interposition of soft tissue.

The changes observed in the direct roentgen picture showed that, as a rule, the arthrosis was confined to, or was more pronounced on, the side of the joint where the meniscal lesion was observed. When the two knee joints were compared, it was found that the affected side more often showed roentgenological signs of arthrosis. In early cases this change consisted only of an osteophyte on the tibial condyle near the cartilage edge. In chronic cases osteophytes were present on both the tibia and femur, and sometimes there was recession of the height of the articular cartilage and subchondral sclerosis. In general, osteophytes did not appear until a few months or years after the injury or beginning of the lesion. The tendency to develop such arthrosis increases with age.

The author concludes that as a result of a meniscal lesion an osteophyte usually appears on the adjacent tibial condyle after a short time. By comparison with the healthy side, it is possible to detect this arthrosis at an early stage. Confirmation of a meniscal lesion can be obtained by arthrography in the majority of cases, fissures of the meniscus being the most important sign. JOHN L. LINDQUIST, M.D.

**Krogdahl, T.: Roentgen Diagnosis of Dislocation of the Menisci of the Knee Joint without the Use of Contrast Media** (Roentgenologische Diagnose der Meniskusluxation im Kniegelenk ohne Verwendung von Kontrastmitteln). *Acta radiol.*, 1940, 21: 335.

Under normal circumstances the articulatory surfaces of the tibia and femur touch the menisci of the knee joint or each other, and there is no "tissue-free" space between them. Nordheim has shown that such a tissue-free space, presumably containing gas under low pressure, can be produced by traction, and shown as a cleft on roentgen plates.

The technique in Krogdahl's studies follows:

The legs are extended, and the knees fastened to each other by a linen bandage. The lower legs are abducted by traction on the ankles in a knock-kneed position. The patient must not flex the knees or rotate in the hip joints. The exposure is done according to the technique used in ordinary anteroposterior pictures; however, the central beam should form an angle of from 75 to 85 degrees, open toward the head. Soft rays and short exposure should be used.

The method is diagnostically useful in that it discloses minimal amounts of fluid in the joint. No gas space is visible if there is blood or free fluid present.

Normally the distance from the femur to the tibia increases under forced knock-kneed abduction, but not more than 2 or 3 mm. A larger increase points to rupture of the capsule and/or of the collateral ligament, especially when there is only a unilateral excess increase. A diagnosis of meniscus lesions by this method is possible only if there is no free fluid in the joint.

Eighteen patients with a possible meniscus lesion were studied. In 2 of them the lateral meniscus was involved, and the method failed. In 10 of the remaining 16 patients the articulatory cleft could not be shown; however, 6 of these had considerable amounts of fluid in their knees. In 2 more patients there was a marked increase of the medial bone distance which suggested the diagnosis of rupture of the capsule. In 6 patients, there was distinct visualization of the articulatory cleft and meniscus. In 2 of these patients the meniscus findings were normal. A third patient showed doubtful findings, and in 3 patients (4 knees) the diagnosis of luxation of the meniscus was made definitely. As this diagnosis never has been made to date without contrast substances, these cases are reported in detail, and 1 report is given here:

A boy of eighteen had a history and findings typical for a medial meniscus lesion of the right knee. Ordinary roentgen pictures were negative. Pictures made according to Nordheim's technique showed a normal wedge-shaped medial meniscus on the left side (Fig. 2) and a shortened meniscus with the free margin "cut off" on the right side (Fig. 1). Operation affirmed the diagnosis. HEINRICH LAMM, M.D.

## RADIUM

**Pohle, E. A., and McAneny, J. B.: Radium Treatment of Vascular Nevi.** *Am. J. Roentgenol.*, 1940, 44: 747.

Vascular nevi may, for practical purposes, be grouped according to the simple classification of MacKee. He divided the vascular nevi into nevus flammeus (portwine mark), nevus vasculosus (strawberry mark), and angioma cavernosum (cavernous angioma). There are, of course, many mixed types.

The cause of vascular nevi is still debated. Ribbert's theory, which assumes their development from embryonic rudiments, is most plausible.

As to the optimum time of treatment, the consensus of opinion is that the earlier the treatment is given the better, but it should certainly be given during the first year of life. The most satisfactory results are being obtained, except in the case of the portwine mark, from the use of radium.

The authors, after briefly reviewing the various methods of radium therapy applied most commonly, describe their own method, which is somewhat individualized from case to case, although as a rule doses leading to an erythema are avoided. For superficial lesions, plaques with 0.1 mm. aluminum filtration are used. A 2 by 2 cm.$^2$ plaque can be applied for up to an hour on an area of 1 cm.$^2$ and correspondingly less for a larger area down to ten or fifteen minutes. Treatment may be repeated within four to eight weeks if necessary. For lesions thicker than 0.5 cm. or subcutaneous angiomas radon screens filtered with 0.5 mm. silver and 1 mm. brass or with 2 mm. brass alone are employed, placed on wood applicators or dental compound molds from 1 to 3 cm. thick, so as to obtain a certain distance and thus a more uniform distribution of the irradiation. The dose varies according to the thickness of the lesion from 20 to 40 m.c. hr., but a single dose of 300 m.c. hr. at 3 cm. distance is never exceeded. If the lesion extends over a large area, multiple applications with smaller fields are used, which leaves a margin of from 3 to 4 mm. between the fields. In such cases an interval of from three to six months is allowed between treatments.

During the last two years, angiomatous nevi have occasionally been treated by radium puncture. Needles 2.5 cm. long, with a 1 mgm. radium element content and a wall thickness of 0.5 mm. of platinum are inserted radially from 1 to 1.5 cm. apart and retained *in situ* by sutures for forty-eight hours.

A series of 146 cases of vascular and cavernomatous nevi is analyzed as to the final results. According to the figures compiled, 60 per cent of the patients were definitely cured and most of the others were benefited. The percentage of failures was very small, amounting to only 2.2 per cent.

T. Leucutia, M.D.

**Nielsen, J.: Clinical Studies on the Irradiation Treatment of Cancer of the Esophagus** (Klinische Versuche zur Strahlenbehandlung des Speiseroehrenkrebses). *Acta radiol.*, 1940, 21: 352.

Nielsen reports on 154 cases of cancer of the esophagus treated from 1913 to 1938 in the Radium Station in Copenhagen. He divides them into two groups: the first was treated before 1931, chiefly palliatively—gastrostomy was frequently done on these patients and they all died in a short time. The second group was treated after 1931 with more intensive radiation; curative treatment was attempted in 17 of these patients. Coutard's method of fractionated protracted irradiation was tried. The results in this group were a marked shrinkage of the tumor with frequent restitution of swallowing at least for some time. Eight patients survived longer than one year. Three of these appear clinically free of recurrence, and so far represent 2 cases of four-year-cure and 1 of three-year-cure. In addition there is 1 patient classified as having had cancer of the hypopharynx with a six and one-half-year-cure who properly should be classified as having had carcinoma high up in the esophagus. Coutard's method is so effective in carcinomas high up in the esophagus that Nielsen believes its employment to be mandatory.

In intrathoracic tumors the technique is more difficult, and the treatment is very hard on the patients. In the selected patients who are strong enough to undergo the treatment, Nielsen supplements the roentgen dose (10,000 to 14,000 roentgens) with small radium doses applied internally. Radium treatment alone is not a curative treatment of cancer of the esophagus. Besides, radium treatment is dangerous because of the possibility of perforation.

Tumors of the upper part of the esophagus are treated like hypopharynx tumors. Usually from 3 to 7 fields are used, including fields from the back. The doses range from 125 to 200 roentgens per treatment, and usually two treatments are given daily. The total dose is from 6,000 to 12,000 roentgens. The author uses 180 kv., 6 ma., 50 cm. for distance, and the Thoraeus filter. The average treatment time is from six to seven weeks. In 20 per cent of the cancers high in the esophagus cures can be expected with further development of irradiation technique. Before high voltage machines are available there is but little hope to improve the results of irradiation in lower esophageal cancers. Heinrich Lamm, M.D.

# MISCELLANEOUS

## CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

**Fingerland, A.: Amebiasis of the Skin. A Contribution to the Etiology of the So-Called Postoperatively Progressing Gangrene of the Skin** (Amoebiase der Haut. Beitrag zur Aetiologie der sogenannten postoperativ-fortschreitenden Hautgangraen). *Časop. lék. česk.*, 1940, p. 705.

Tropical dysentery may not only be introduced but occurs also endemically in temperate and cold zones. It appears often under forms which deviate greatly from the classical picture, with or without diarrhea, as undetermined abdominal disturbances, as suppurating and non-suppurating processes of the liver, as metastatic abscesses of the brain and spleen, as ulcerating inflammation of the urinary tract, and also as severe, progressing ulceration of the skin. Therefore, the term of amebiasis of the skin has been used lately. It occurs under the following forms: (1) after operations, under the picture of a progressive gangrene in the neighborhood of the wound; (2) after spontaneous perforation of amebic abscess, mostly localized in the skin of the abdomen or chest; (3) spontaneous origination in the neighborhood of the anus; and (4) without relation to old processes, but most probably due to hematogenous metastases.

The most frequent form is that of postoperative, progressing gangrene which occurs in most cases as a complication after abdominal interventions. Its period of incubation varies from two to sixty days, but is generally barely fourteen days. The amebiasis usually begins in the vicinity of the wound as a red spot in which a nodule soon forms and then ulcerates. The ulcer spreads 2 or 3 mm. each day and may reach a diameter of 50 cm.; however, it does not extend in depth, but stops at the fascia. The edges of the wound are extremely sensitive even to the slightest touch. The regional lymph nodes are not involved. Usually, the temperature does not exceed 38.5° C., but the leucocytosis may reach 20,000. The only treatment to be considered is extensive excision far into the healthy tissues and including the base of the ulcer.

The author describes a case in a man who contracted real amebic dysentery in Siam and presented continuous disturbances for twenty-four years. At first he was treated for gastric ulcer and then for ulcerating colitis; finally, he had such severe stenosis of the sigmoid that, because of ileus, a colostomy had to be performed: amebiasis of the skin developed from the borders of the wound. The correct diagnosis was made only at autopsy by the demonstration of the presence of the entamœba histolytica in the wound and the intestinal ulcers.

The author points out that postoperative, progressing ulcerations must always be suspected of amebiasis and that a search for amebas is in order in such cases. There is also the possibility of amebic embolism. The main diagnostic elements are the laboratory examinations: (1) of the stools and the secretions of the ulcer for vegetative forms of amebas; (2) of the stools for cysts of amebas;(3) attempts at transmission to cats; (4) attempts to obtain an ameba culture; and (5) (exceptionally) microscopic examination of the tissues. The article is accompanied by beautiful illustrations of the amebas. (Golla). Richard Kemel, M.D.

**Schuberth, O.: Shock and Blood Transfusion** (Shock und Bluttransfusion). *Svenska läk.-tidning.*, 1940, p. 900.

Shock in the sense of collapse (as used by the author) is brought about when certain physiologico-anatomical factors that regulate the circulation of the blood are negatived or too greatly exaggerated, so that the least amount and the least pressure of blood drop so far from the normal that the blood circulation is not adequate to life even in important parts of the body. When external hemorrhage occurs, it is balanced at the beginning by a liberal flow of blood from the liver, the spleen, and the large arteries, and by the contractions of the superficial vessels of the skin, but when it extends beyond a certain limit and prevents a sufficient blood supply from the arteries to reach the heart then shock is the result. If shock is threatened or already present, everything should be avoided that could possibly influence the circulation of the blood unfavorably, such as narcosis, operation, reduction or elevation of the body temperature, and psychic trauma. Shock depends upon a disturbance of the normal relationship between the caliber of the blood vessels and the amount of blood; the latter may be too sparse, the former too large. The treatment should be either the use of agencies that diminish the caliber of the blood vessels (adrenalin, ephedrine, coramine) or, in the second case, measures which increase the amount of blood (the intravenous injections of fluids or blood transfusion). There are five groups of shock-producing causes which govern the treatment of patients: (1) massive external or internal hemorrhage, or delayed hemorrhage, (2) severe injuries (traumatic shock), (3) septic conditions (after wound infections), (4) peritoneal inflammations, and (5) burns, e.g., of the skin or by gases.

According to Cannon, the experiences during the World War showed that the products of disintegration of the albuminous elements in macerated parts of the body caused traumatic shock by intoxication, as when an Esmarch bandage was removed from a macerated limb. The American surgeon, Blalock, claims that traumatic shock is caused by the loss of blood and fluids from the macerated tissues of a limb and is similar to hemorrhagic shock. Some authorities claim a reflex origin of shock (neurogenic

shock). When shock occurs late in a disease, the toxin content of the blood must be considered as a cause.

The most important preventive measures against shock are blood transfusion and the infusion of fluids into the blood vessels. The blood transfusion has the advantage that not only fluids and salts, but also hemoglobin, albumin, and hormones are supplied, and that their benefits are relatively more enduring than those of infusion of physiological sodium-chloride solution. The latter substance has the advantage of being more simply and easily administered in larger amounts—this is especially important in infectious conditions (wounds) when the drop-method can be employed. The drop-method is very effective in mammary and abdominal surgery, also on the battlefield. The infusion can, in a large measure, replace the transfusion; the latter should never be done in hopeless cases (Rietz). The Swedish methods employed in the war are the storage of sterile physiological salt solution in Vichy water bottles; eventually calcium, potassium, and sulfur may be added. Necessary apparatus for the drop-method and for percutaneous infusion should always be at hand. Blood transfusion is given according to the method of Jeanbrun or direct from donor to recipient. As a safeguard against coagulation, citrate (30 c.cm. of 10 per cent solution, in 500 c.cm. of blood) is employed. Heparin to replace citrate is recommended by the state, but its value is too little proved to be adopted.

These treatments may be given in the main first aid station or in the sectional hospital. As a donor, a lightly wounded soldier may be accepted (only exceptionally a member of the nursing staff). At a temperature of 4° C. the blood may be stored two or three weeks and it will be chemically and biologically as valuable as fresh blood. As a rule, blood should not be stored longer than one week; if slight hemolysis has occurred the blood should not be transfused. In the World War practically no blood was used except that obtained directly from the donor. In the Spanish War, especially on the Republican side, stored blood was used. A large laboratory in Madrid furnished enough blood, stored for one year, for 9,000 transfusions. In the Russian-Finnish War, also, a large number of bloodbanks (blood stored in bottles) was utilized. The preserved blood must be kept cool. In Spain the transportation and storage of blood were well regulated: refrigeration-autos (ice autos and meat autos) were used. The best method was employed in Sweden: the blood was drawn from the donor into ordinary Vichy water bottles which were stored in cool places. The transfusion was given with metal tubes.

The question of blood grouping may be solved as follows:

1. The grouping is done by testing the serum immediately before the transfusion.

2. Blood grouping during peace times can be done for draftees and recorded in the war lists on an identification tag.

3. None but universal donors should be accepted for then the grouping of the recipients is not necessary. If wounded soldiers are taken as donors, they must be grouped. In the literature there are reports of complications arising from too great a content of agglutinin in the plasma of the donor which influenced the blood corpuscles of the recipient; despite the 1:10 dilution many succumbed. On account of similar occurrences, especially in chronic patients, the author advises using the universal donor method, with biological tests in each case. This has the advantage that a supply of only one blood group need be stored.

A sufficient number of universal donors can undoubtedly be found during peace times, but only by proper organization. Blood from a dead body should not be used (Russian method).

Notwithstanding simplified technique, transfusion is somewhat difficult because of certain precariousness in the blood bank distribution. It is much simpler to prepare for storage a large amount of sterile salt solution; this is easy to make, and may be stored for a long time.

Regarding the means of combating shock, the various hospitals, as well as first aid stations, should have at hand morphine, ephedrine, and veritol, as well as means for supplying heat. The main first aid station should be furnished with a liberal supply of normal salt solution for infusions and have arrangements for giving blood transfusions. In the sectional hospital the question arises whether intravenous infusions of fluids or blood transfusions should be given to the wounded soldier. While the patient in shock should not be subjected to surgery, his condition may demand the immediate operation of extensive wounds or amputation and therefore, preoperative infusions or transfusions are resorted to in active practice. Then the problem of postoperative treatment with intravenous infusions of fluids must be solved; and for this the drop-method apparatus should be provided whenever possible.

(Richter). Mathias J. Seifert, M.D.

**Tanturi, C. A., and Banfi, R. F.: Studies on Prothrombin. Adsorption of Prothrombin. Calculation of Concentration** (Estudios sobre protrombina. Adsorción de la protrombina. Cálculo de la concentración). *Semana méd.*, 1940, 47: 1261.

In previous articles the authors have discussed the technique for determining the concentration of prothrombin in the blood plasm of human beings and rabbits. In this article they discuss the adsorption of prothrombin and the calculation of its concentration. Details of the chemical technique and tables showing the results are given.

The best pH for the coagulation of blood is between pH 6 and pH 8. Rabbits of different races and coming from different places show a varying thromboplastin content in the brain powder obtained from them. This variation and the method of preserving the brain powder are important factors in the activity of the thromboplastin emulsion. The author be-

lieves that the length of time between the death and the decerebration of the animal also has an effect.

Prothrombin is adsorbed by many substances. The author found barium sulfate most effective.

In calculation of the concentration, the plasma to be examined is dilated with plasma from which the prothrombin has been removed. The concentration of prothrombin is calculated by determining the coagulation time of different dilutions of plasma.

AUDREY G. MORGAN, M.D.

**Mogensen, E.: Three Cases of Simmonds' Syndrome.** *Acta med. Scand.*, 1940, 105: 378.

The author reports 3 cases of Simmonds' syndrome which are summarized as follows:

CASE 1. The patient was a man thirty-nine years of age. Ten years before treatment he had, following a febrile disease, developed the following symptoms: loss of weight, asthenia, atrophy of the external genital organs, impotency, loss of hair, and changes in the skin. Examination further showed decrease in the basal metabolic rate, anemia, hypotension, and a tendency toward hypoglycemia and hypothermia; x-ray examination of the sella turcica showed a slight dilatation; examination of the eyes revealed bitemporal quadrant hemianopsia to a colored object; and estimation of hormones revealed a pronounced decrease in the figures for gonadotropic and testicular hormone.

Under intense treatment with gonadotropic hormone from the urine of pregnant women (physex leo) a very striking improvement took place. The patient gained 12 kgm. in weight, the growth of hair and the sexual function became normal; the basal metabolic rate and blood-pressure likewise became normal. During a period of observation of two years he has felt perfectly well under a maintenance treatment with physex.

CASE 2. A man fifty-five years of age had developed the following symptoms over a period between ten and fifteen years: loss of weight (20 kgm. in all), pronounced debility, genital atrophy, impotency, loss of hair, and changes in the skin. Examination revealed a low basal metabolic rate, achlorhydria, and anemia; x-ray examination showed a considerable dilatation of the sella turcica; examination of the eyes revealed bitemporal hemiachromatopsia; and an estimation of the hormones in the urine showed much reduced values for gonadotropic and testicular hormones.

Treatment with gonadotropic hormones (physex leo) caused a very marked improvement of the patient's physical and mental condition, so that he was again able to attend his work; his hair also became thicker, and there was some development of the genital organs; the sexual functions were not restored. The improvement obtained has lasted three and one-half years under continued treatment with physex.

CASE 3. The patient was a woman of forty-eight years of age, in whom the menopause had occurred at the age of twenty-six; at the same time she lost the hair of her axillæ and pubes. During the following years there was a great loss in weight, about 25 kgm. in all. Examination showed premature senility, emaciation, pronounced atrophy of the genital organs, changes in the skin, reduced basal metabolic rate, anemia, and low blood-sugar values with severe hypoglycemic attacks. Hormone determinations showed strongly reduced values for gonadotropic hormone and estrin. X-ray examination of the sella turcica and ophthalmological examination did not reveal any abnormalities.

By the administration of frequent meals to the patient it was possible to keep her free of pronounced hypoglycemic symptoms. Treatment with an alkaline extraction of the anterior lobe of the pituitary gland caused some rise in the blood-sugar values, but the effect was not constant enough to make possible an effective treatment.

Treatment with gonadotropic hormone was unable to improve the condition. Treatment with estrin was accompanied by fair improvement. The patient, who at the time of admission was cachectic, was discharged in a relatively good condition, which has lasted during an observation period of more than two years. During this period she put on 6½ kgm. of weight.

The cause of the syndrome was most clear in Case 2. The author believes that presumably he was dealing with a chromophobe adenoma of not a small size, as the sella turcica was considerably dilated and there was a bitemporal constriction of the visual field. Cases of Simmonds' syndrome caused by chromophobe adenomas have been described in the literature. The insufficiency of the anterior lobe of the pituitary gland may be explained by an adenoma of the endocrinely inactive cells which displaces or compresses the endocrinely active chromophil cells.

In Case 1 the pathological substratum was more uncertain. The disease manifested itself following a highly febrile infectious affection which may possibly have caused vascular disorders of the pituitary gland, followed by necrosis; other possible explanations of the sudden onset might be: disease of the meninges with a secondary fibrous process, or hemorrhage in a preëxisting pituitary tumor. The roentgenological and ophthalmological changes speak in favor of a tumor, most likely a chromophobe adenoma as in Case 2, but of a far smaller size.

In the third patient there were no signs of tumor of the pituitary gland or its surroundings; this case represents Simmonds' syndrome in the strictest sense. It goes without saying that it can only be guessed that this case presented the sequel of a post-partum necrosis of the anterior lobe of the pituitary gland, as did the first case described by Simmonds.

SAMUEL H. KLEIN, M.D.

**Mogensen, E.: Simmonds' Syndrome.** *Acta med. Scand.*, 1940, 105: 360.

A description is given of Simmonds' disease, or—a better name—Simmonds' syndrome. This con-

dition is defined as a chronic, progressive affection, due to failure of the endocrine function of the anterior lobe of the pituitary gland, and is characterized by the deficiency symptoms produced thereby.

The syndrome arises as the result of different pathological processes in the pituitary gland or its vicinity. The most important clinical symptoms are: loss of weight; asthenia; atrophy of the genital organs; (with decreased sexual function in females) amenorrhea, (in males) impotence; loss of the axillary and pubic hairs; in males loss also of the beard; changes in the skin; and decreased basal metabolic rate. Less consistent symptoms are: hypotonia, hypothermia, bradycardia, hypoglycemia, gastrointestinal disorders, anemia, and achlorhydria. It is emphasized that cachexia is a late phase in the development of the disease and by no means a necessary symptom without which the diagnosis is not possible. The differential diagnosis, particularly from anorexia nervosa, is discussed. It is pointed out that a large number of the cases which have been published as being Simmonds' disease must be interpreted as cases of anorexia nervosa. This fact is very important as far as evaluation of therapy is concerned, particularly the therapy which consists in implanting pituitary grafts.

Treatment with gonadotropic hormones of sufficient effectivity and in sufficiently large doses is the most promising. By this treatment it may be possible to produce a striking improvement in the general condition and to counteract the most important deficiency symptoms in Simmonds' syndrome. SAMUEL H. KLEIN, M.D.

**Moersch, F. P., Love, J. G., and Kernohan, J. W.: Melanoma.** *J. Am. M. Ass.*, 1940, 115: 2148.

In the ten-year period from 1930 to 1939, inclusive, the authors saw approximately 500 patients who had melanoma. This number represents about 2 per cent of the total number of patients suffering from malignant lesions seen during that period. Unfortunately, complete follow-up study in the 500 cases was not possible; therefore, accurate deductions could not be made. In approximately a fourth of the cases of melanoma the primary tumor was situated in or about the eye, and in at least 347 of the 500 cases there was evidence of local recurrence or metastasis at the time the patients were last seen at the clinic. The majority of the patients died. In at least 34, or 10 per cent, of the 347 cases there was clinical evidence of melanotic involvement of the central nervous system.

In 24 cases the brain was the site of the melanotic involvement. In 10 cases the spinal cord was affected. In 1 instance, both the brain and spinal cord were affected. In 19 of the 34 cases the diagnosis was verified by microscopic examination of a specimen removed from the brain or spinal cord at operation, or by necropsy. In the remaining 15 cases, necropsy was not performed or did not include examination of the central nervous system. Twenty-four additional cases in which there was no postmortem or operative confirmation were excluded, but the authors called attention to this additional group because "in a study of this type one cannot fail to be impressed by the fact that metastatic involvement of the central nervous system by melanomas is much more common than is generally appreciated."

Failure to appreciate the importance of melanotic involvement of the central nervous system was said by the authors to be due to several factors. Following a diagnosis of melanoma with evidence of metastases, the patient is frequently taken home and dies without a post-mortem examination. Again, in the absence of a primary melanoma of the skin or in some other obvious site, a patient may die without a proper diagnosis and the correct diagnosis may be established only by necropsy, which is performed only occasionally (Plewes). The very late occurrence of metastasis from a primary melanoma may also lead to an incorrect diagnosis.

Of the 34 patients, 23 were males and 11 were females. Operation was performed in 11 cases; in 6 for tumor of the brain and in 5 for tumor of the spinal cord. It is noteworthy that in 12 cases the presence of a melanoma was not suspected prior to operation or necropsy. In 8 of the 12 cases no primary melanoma was discovered. In 3 cases, after the melanoma in the nervous system was found, the patient or family revealed the fact that a mole had been removed previously. In the remaining case the eye had been enucleated some time previously. A diagnosis of glaucoma had been made but because of the subsequent course of events the eye undoubtedly must be considered as the site of a primary melanoma.

The ages of the patients at the time of examination at the clinic because of symptoms referable to the central nervous system ranged from four years to sixty-six years. The length of time from the excision of the primary melanoma or mole to the death of the patient varied from four months to thirteen years. The average duration was approximately two and a half years. The authors said that it is pertinent to this problem to insist that moles situated in places subject to irritation should be excised before they show any signs of "wildness." The site of the known primary mole was as follows: back, in 10 cases, head, face, and neck in 5 cases; eyes in 6 cases; heel in 2 cases; hand in 1 case; umbilicus in 1 case; labium in 1 case, and unknown in 8 cases. The length of time the mole was present before removal varied from one to thirty-eight years. In a few instances the patient stated that the mole had always been present. As a rule some fourteen months had elapsed between the removal of the initial mole and the first signs of metastasis.

In only 1 of the 34 cases in our series was there metastatic involvement of both the brain and spinal cord. In 3 cases the melanoma appeared to be primary in the brain and in 3 cases it appeared to be primary in the spinal cord. In these 6 cases operation was performed and the diagnosis was made by biopsy.

In 11 of the 24 cases of melanoma of the brain the outstanding clinical symptoms, such as mental dullness, confusion, coma, and delirium, pointed to involvement of the brain. In 2 cases the clinical picture was confused by the presence of a bromide psychosis or drug intoxication. Several of the patients were moribund when they were brought to the hospital and the correct diagnosis was made only at necropsy. The cerebrospinal fluid was examined in 3 cases of melanoma of the brain. In 2 cases the fluid was entirely normal. In the remaining case the value for the total protein was 50 mgm. per 100 c.cm. of fluid and there were 67 lymphocytes in each cubic centimeter of fluid. In no instance was melanin discovered in the spinal fluid.

Roentgenographic examination of the skull was of little value in the diagnosis of melanoma of the brain. In 5 instances roentgenographic examination of the thorax showed evidence of metastatic involvement and in 2 additional cases the results of such examination were suggestive of metastatic involvement. Loss of weight was a common symptom. In 5 cases the sedimentation rates of the erythrocytes were 10 mm., 18 mm., 24 mm., 64 mm., and 109 mm. at the end of one hour, respectively. In only 1 instance was melanin discovered in the urine, but tests for melanin in the urine were not carried out routinely in this series of cases.

The authors declared that it was evident from a survey of their post-mortem material that metastatic melanoma may occur throughout the organs of the body without involvement of the central nervous system, and similarly, though to a lesser degree, the brain or spinal cord may be the only site of metastatic involvement.

In the differential diagnosis of melanoma, they wrote, it must be remembered that the patient or relatives frequently will fail to mention the previous removal of a mole. As a rule, such information is withheld unintentionally but in a few cases in their series the knowledge of a mole was deliberately withheld because of the previous unfavorable prognosis.

The authors believed that little can be accomplished by operation in cases of melanoma of the central nervous system, but also that a defeatist attitude in regard to this serious affliction should not be adopted. They said that in a small percentage of cases a great deal of palliative relief, even if not actual cure, can be obtained by radical operation. If the melanoma is primary in a so-called silent area of the brain, radical surgical removal may be justified; if the lesion is single and nodular, even though metastatic, complete removal may be possible. If the lesion cannot be extirpated from the brain, palliative subtemporal decompression may afford relief from the increased intracranial pressure and its consequent headache, vomiting, and failing vision.

If the melanoma is intraspinal and does not invade the spinal medulla, complete removal is possible. Even if it involves one or more nerve roots, these might be sacrificed in a radical surgical procedure without endangering the patient's life. If the spinal cord or intraspinal nerve roots are involved by a neoplasm and if the tumor is not too extensive, subtotal removal is not only justifiable but definitely indicated to ameliorate the patient's symptoms.

These tumors spread either by blood stream or by lymphatic pathways or, usually, by both; the original tumors have a tendency to invade blood spaces early and this explains their wide dissemination throughout the body. It is difficult to understand why in some cases there may be a latent period of many years between the excision of the original tumor and the appearance of the secondary masses. This late recurrence of metastasis is misleading and disconcerting to all concerned in dealing with the problem.

The authors concluded that melanoma of the central nervous system is a diagnosis that must be reckoned with by the neurologist; that careful inquiry about the removal of pigmented lesions should be carried out, and, if possible, any available material should be reëxamined for the presence of melanoma. It must be realized that a melanoma occasionally may be primary in the central nervous system, and that in the presence of any rapidly progressive lesion of the central nervous system such a diagnosis must be seriously considered. Although it is not in the realm of the neurologist to advise patients regarding lesions of the skin, the opportunity of preaching prophylaxis in the presence of pigmented moles must not be overlooked.

## DUCTLESS GLANDS

**Mussio-Fournier, J. C., and Albrieux, A.: A Contribution to the Study of the Absorption of the Sex Hormones by the Skin** (Contribution à l'étude de l'absorption des hormones sexuelles par la peau). *Presse méd.*, Par., 1940, 48: 569.

Mussio-Fournier and Albrieux and their associates have demonstrated by animal experiments that folliculin is absorbed through the skin; other investigators have reported similar findings. In 1935, one of the authors (Mussio-Fournier) and his collaborators were the first to use the cutaneous route for the treatment of cases of facial hypertrichosis and acne. Sixty per cent of the cases of facial hypertrichosis were cured by the local hormone treatment, and favorable results were obtained in 3 of 7 cases of acne; acne is not always due, the authors note, to ovarian hypofunction. Good results have also been obtained in the treatment of vulvar pruritus and kraurosis by the local application of an ointment containing 250,000 international units of estradiol benzoate per 60 gm. In facial hypertrichosis and acne, the absorption of folliculin by the skin is shown by the fact that general symptoms were relieved as well as the local lesions.

However, the hormone evidently has a local action also; this was shown in a case of facial hypertrichosis in a woman twenty-three years of age to whom estradiol dipropionate and later progynon B

were given in oily solution by intradermal injection. The injections were given at first only on one side of the face and the depilation was much more marked on the treated than on the untreated side. This patient showed other symptoms of ovarian hypofunction, including amenorrhea, and determination of the folliculin hormone content of her blood showed it to be definitely below normal.

Animal experiments carried out by the authors and their associates have shown that the male hormone also is absorbed by the skin. They have not used the male hormone clinically by local application, but others have reported good results with local application of testosterone in the form of an ointment.

ALICE M. MEYERS.

**Sprunt, D. H., and McDearman, S.: The Relationship of Sex Hormones to Infection.** *Endocrinology*, 1940, 27: 893.

It has previously been shown that pregnancy, pseudopregnancy, and the estrogenic hormone modify the rabbit's response to virus infection, and that there is a close relation between the spread of India ink in the skin and the rabbit's susceptibility to infection.

Experiments are described which show that wide variation in the spread of particulate matter in the skin occurs in so-called normal rabbits. However, under controlled conditions, this spread can be reduced. The estrogenic hormone and pseudopregnancy significantly reduce this spread. The effect of castration is reduction of the spread, which later returns to normal, though the return to normal may take as long as six months.

A few experiments indicate that the male hormone does not affect the spread of India ink, but that the amount of spermatogenesis present in the adult male is closely related to the susceptibility of the animal to infection. The relationship of this spread to susceptibility to infection is shown to be close.

Further work is needed on the effect of dispersion and concentration of both bacteria and viruses. The information now available indicates that certain disease agents, such as vaccinia, are aided by anything that causes an increased spread in the skin; other disease agents, such as moderately virulent staphylococci, are inhibited by dispersion. The converse is also found to be true.

SAMUEL KAHN, M.D.